# NEOSHO BASIN TOTAL MAXIMUM DAILY LOAD

## Waterbody / Assessment Unit: Cow Creek
## Water Quality Impairment: Total Phosphorus

## 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin**: Spring

**Counties**: Cherokee and Crawford

**HUC8**: 11070207 **HUC10** (12): 04 (01, 02, 03, 04, 05)

**Ecoregion**: Central Irregular Plains, Cherokee Plains (40d)

**Drainage Area**: Approximately 239.8 square miles

**Water Quality Limited Segments Covered Under this TMDL**:

| ***Station*** | ***Main Stem Segment*** | ***Triutary*** |
|---|---|---|
| Stations SC567 | Cow Creek (16) | Long Branch (21) |
| | | Taylor Branch (25) |
| | | Brush Cr (26) |
| | | E. Cow Cr (24) |
| | | First Cow Cr (27) |
| | | Clear Cr (28) |

**2008, 2010, 2012 & 2014 303(d) Listings**: Kansas Stream segments monitored by station SC567, Cow Creek near Lawton, are cited as impaired by Total Phosphorus (TP) for the Neosho Basin.

**Impaired Use**: Expected Aquatic Life, Contact Recreation and Domestic Water Supply.

**Water Quality Criteria**:
**Nutrients** – Narratives: The introduction of plant nutrient into surface waters designated for domestic water supply use shall be controlled to prevent interference with the production of drinking water (K.A.R. 28-16-28e(c)(3)(D)).

The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life (K.A.R. 28-16-28e(c)(2)(A)).

The introduction of plant nutrients into surface waters designated for primary or secondary contact recreational use shall be controlled to prevent the development of

objectionable concentrations of algae or algal by-products or nuisance growths of submersed, floating, or emergent aquatic vegetation (K.A.R. 28-26-28e(c)(7)(A)).

**Designated Uses**: Cow Creek (16) and First Cow Cr (27): Special Aquatic Life Support; Primary Contact Recreation B; Domestic Water Supply; Food Procurement; Groundwater Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use.

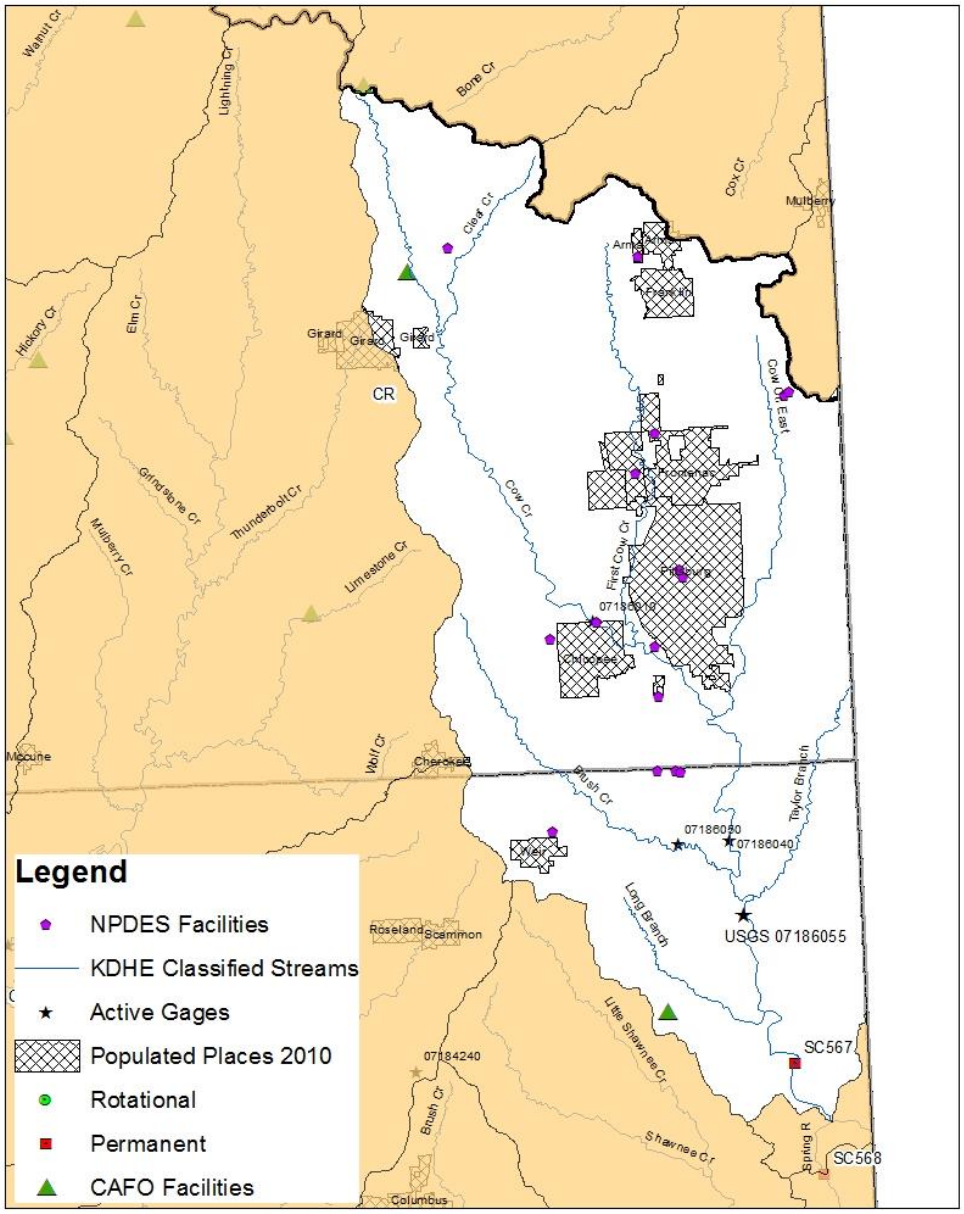
Brush Cr (26), E. Cow Cr (24): Special Aquatic Life Support; Secondary Contact Recreation b; Domestic Water Supply; Food Procurement; Groundwater Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use.

Long Branch (21): Expected Aquatic Life Support; Secondary Contact Recreation b; Groundwater Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use.

Clear Cr (28): Expected Aquatic Life Support; Secondary Contact Recreation b; Irrigation Use; Livestock Watering Use.

Taylor Branch (25): Expected Aquatic Life Support; Secondary Contact Recreation b; Food Procurement; Groundwater Recharge; Irrigation Use; Livestock Watering Use.

**Figure 1**. Cow Creek Watershed Base Map.




## 2. CURRENT WATER QUALITY CONDITIONS AND DESIRED ENDPOINT

**Level of Support for Designated Uses under 2014-303(d):** Phosphorus levels on Cow Creek are consistently high. Excessive nutrients are not being controlled and are thus impairing aquatic life, domestic water supply, and contact recreation.

**Stream Monitoring Sites and Period of Record**: KDHE permanent stream sampling Station SC567 on Cow Creek near Lawton is sampled bimonthly or quarterly each year.

Probabilistic Stream Monitoring Station SPB239 on the upper portion of Cow Creek below the confluence with Clear Creek, sampled quarterly during 2012. Probabilistic Stream Monitoring Station SPA015 on Cow Creek above the confluence with First Cow Creek, sampled quarterly during 2006.

**Hydrology**: Long term flow conditions for Cow Creek at SC567 were estimated by utilizing regression equations (see appendix A) derived from USGS gage 07186055 on Cow Creek (2014), USGS gage 07188000 on Spring River (1990-2014) and USGS Scientific Investigations Report 2004-5033 (Perry, 2004). Long term flow conditions for streams within the Cow Creek watershed are detailed in Table 1.

**Table 1**. Long Term Flow Conditions as calculated from USGS gages 07186055, 07188000 and USGS Scientific Investigations Report (Perry, 2004).

| | | | | Percent Flow Exceedance | | | | |
|---|---|---|---|---|---|---|---|---|
| Stream | Station | Drainage Area (square miles) | Mean Flow (cfs) | 90% | 75% | 50% | 25% | 10% |
| Cow Cr (calculated) | SC567 | 239.4 (in KS) | 111.93 | 3.33 | 10.63 | 33.58 | 99.20 | 316.77 |
| Stream | USGS Site Id | USGS Estimated Flows (Perry, 2004) | | | | | | |
| Second Cow Cr | 4488 | 19.56 | 19.44 | 0.01 | 0.08 | 2.25 | 8.48 | 24.54 |
| Clear Cr | 4487 | 19.69 | 20.22 | 0.01 | 0.1 | 2.4 | 9.02 | 25.94 |
| Second Cow Cr | 4749 | 72.47 | 63.75 | 0.09 | 1.46 | 7.6 | 28.62 | 85.37 |
| First Cow Cr | 4748 | 43.15 | 34.98 | 0.03 | 0.42 | 3.55 | 13.85 | 42.29 |
| Long Branch | 4996 | 13.16 | 11.26 | 0 | 0 | 1.01 | 4.03 | 12.5 |
| Brush Cr | 4877 | 29.1 | 27.59 | 0.02 | 0.44 | 3.48 | 12.61 | 36.04 |
| Taylor Branch | 4895 | 34.68 | 27.07 | 0.02 | 0.24 | 2.69 | 10.4 | 31.71 |
| East Cow Cr | 4790 | 46.59 | 38.01 | 0.04 | 0.57 | 4.04 | 15.47 | 46.76 |

Flow duration curves derived from the regression calculations covering the period of record from 1990-2014 are illustrated for Cow Creek at KDHE sampling station SC567 in Figure 2. Annual flow averages for Cow Creek are detailed in Figure 3. Dry years were observed in 1991, 1996, 1997, 2000, 2003, and 2006, where the average annual flow was well below the long term average flow. Based on annual flow averages, the wetter years where average flows are well above the long term average flows include 1990, 1992, 1993, 1994, 1995, 1999, 2007, 2008, and 2009. As seen in Figure 4, monthly flow averages and medians indicate the months with the highest flows are March, April, May and June. The months with the lowest median flows are August, September, October and November.

**Figure 2**. Flow duration curve for Cow Creek at SC567 and estimated USGS Flow (Perry).

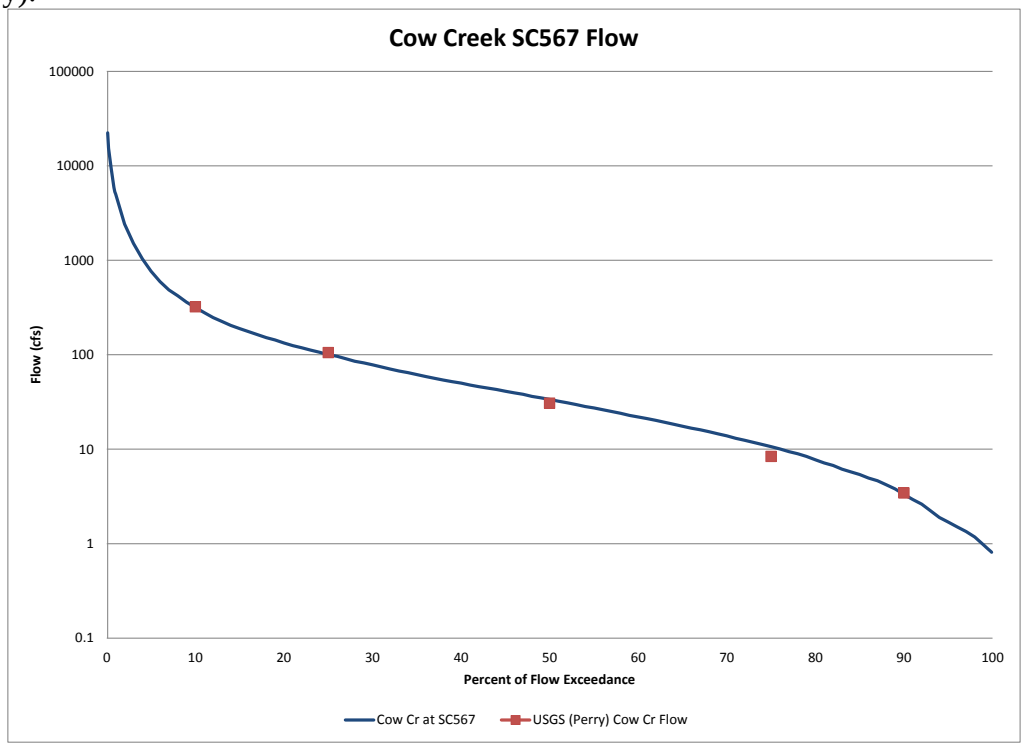



**Figure 3**. Estimated Annual Flow Averages at SC567 on Cow Creek.

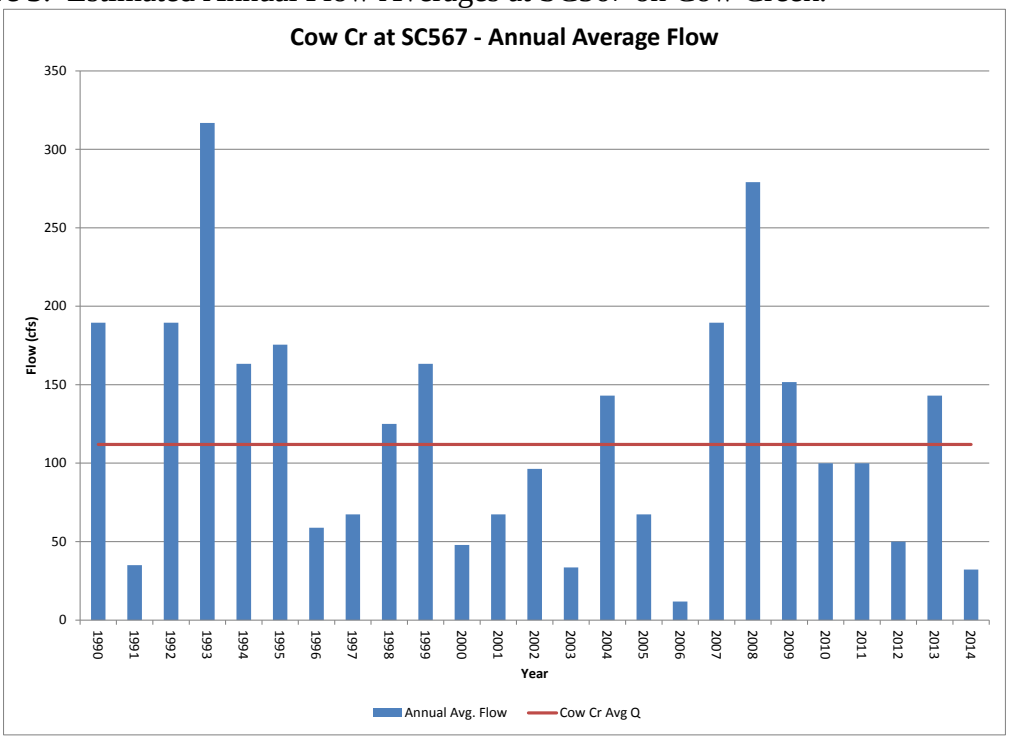
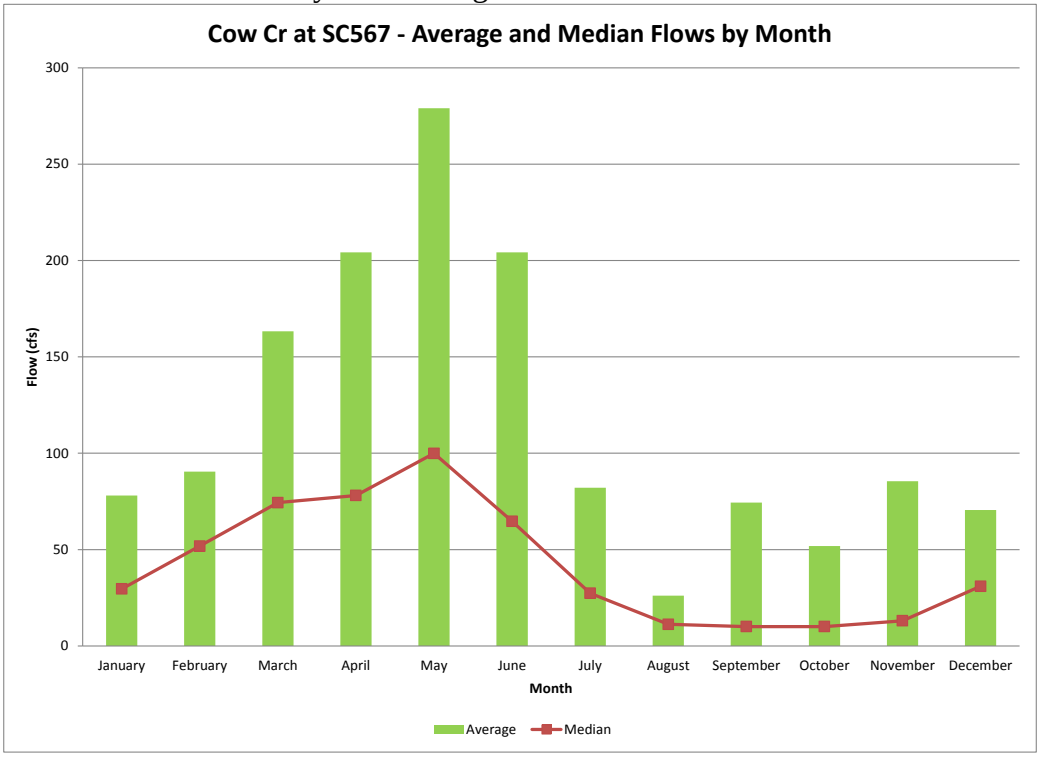


**Figure 4**. Estimated Monthly flow averages at SC567 on Cow Creek.




**Assessment Season**: Seasonal variability has been accounted for in this TMDL. A three season approach was utilized to include: the Spring season consisting of the months of April, May, and June; the Summer-Fall season consisting of the months of July, August, September, and October, and the Winter season that includes January, February, March, November, and December.

**Phosphorus Concentrations**: The overall Total Phosphorus (TP) concentration average is 0.508 mg/L at SC567, with a median concentration of 0.267 mg/L. Seasonal TP averages range from a low of 0.287 mg/L in the Summer-Fall season to a high of 0.868 mg/L in the winter season. Seasonal median concentrations are consistent in the spring and summer-fall season with respective TP concentrations of 0.230 mg/l and 0.233 mg/L. The highest seasonal median TP concentration is in the winter, with a median TP concentration of 0.382 mg/L. Seasonal TP concentrations are further detailed in Figure 5.

Phosphorus concentration averages based on the three defined flow conditions are the highest during the low flow condition (75-99% flow exceedance) with an average of 0.981 mg/L at SC567. During normal flows (25-74% flow exceedance) TP averages 0.365 mg/L and during the high flow condition (0-24% flow exceedance) TP has the lowest average of 0.221 mg/L at SC567. Median TP concentrations for the normal and high flow conditions are 0.26 mg/L and 0.17 mg/L respectively. Median concentrations during the low flow condition are the highest at 0.461 mg/L. TP concentrations based on the flow condition are detailed in Figure 6.

**Figure 5**. Seasonal TP Concentrations at SC567.

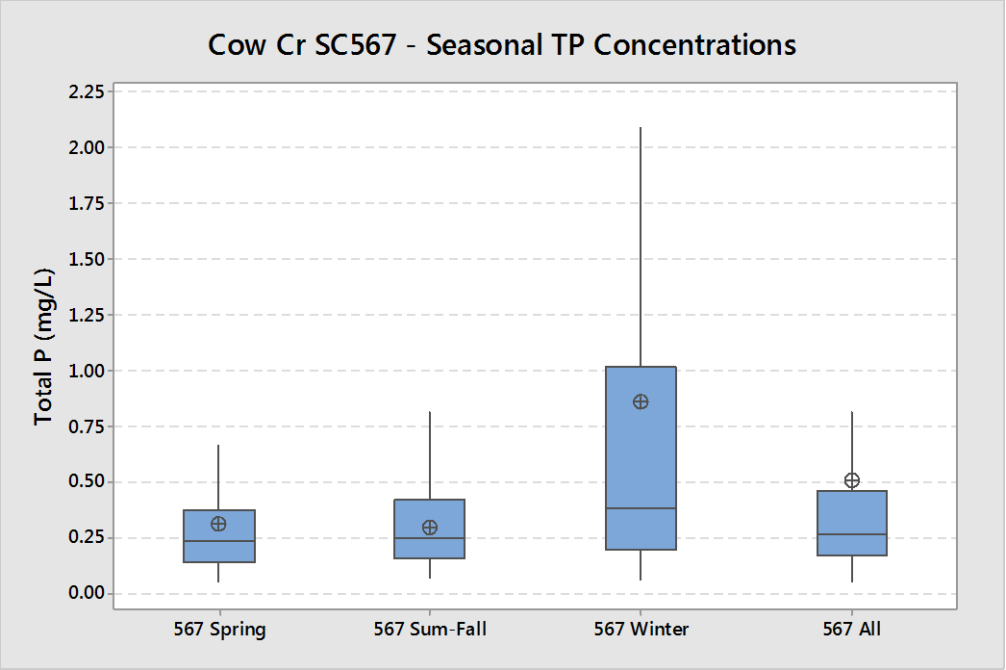
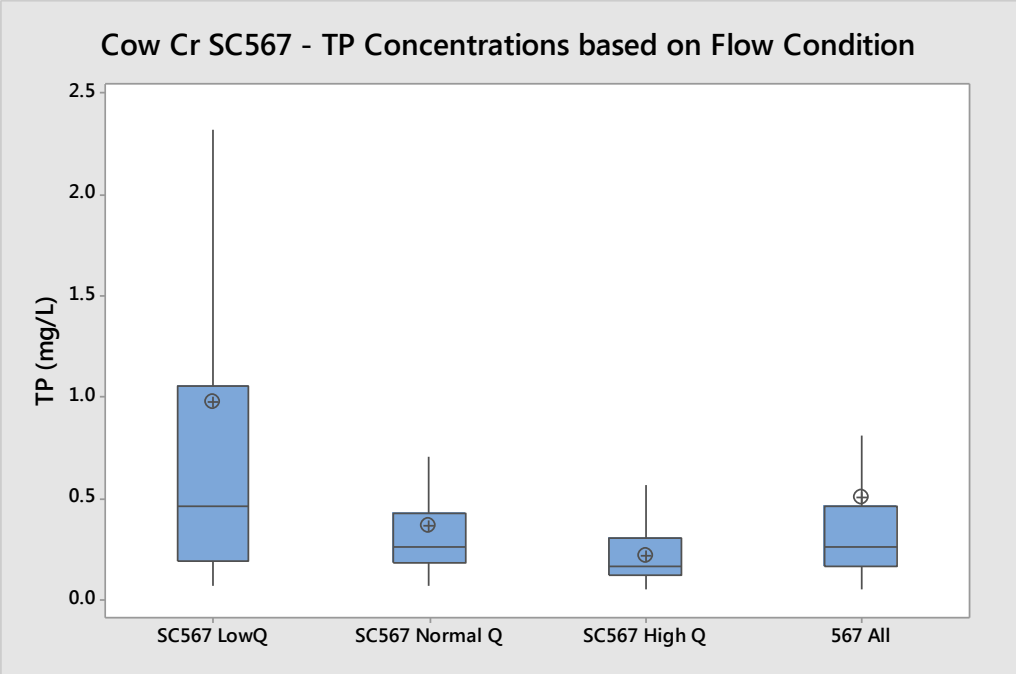



**Figure 6**. TP Concentrations relative to flow condition.

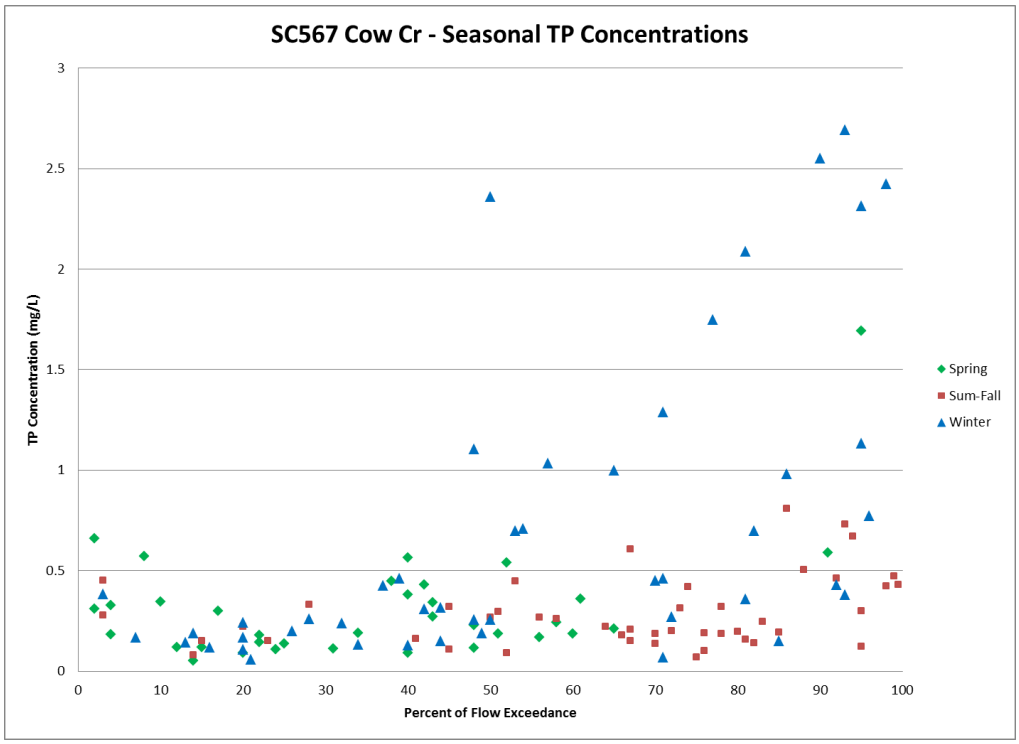


Seasonal TP concentrations based on the flow conditions are further detailed in Table 2 and Figure 7. The highest average TP concentrations are observed during the low flow condition during the winter season and the lowest average TP concentrations are observed during the winter high flow condition. The higher TP concentrations during the low flow condition are indicative of wastewater loading, which in this case is primarily a result of TP loading from the City of Pittsburg's wastewater treatment plant.

**Table 2**. Seasonal average and median TP concentrations based on flow conditions.

| Season / Flow Condition | TP (mg/L) Low Q (75-99% flow exceedance) | TP (mg/L) Normal Q (25-74% flow exceedance) | TP (mg/L) High Q (0-24% flow exceedance) | TP (mg/L) Average | TP Season Median (mg/L) |
|---|---|---|---|---|---|
| Spring | 1.14 | 0.272 | 0.251 | 0.312 | 0.230 |
| Summer-Fall | 0.336 | 0.258 | 0.221 | 0.287 | 0.233 |
| Winter | 1.182 | 0.533 | 0.176 | 0.868 | 0.382 |
| Flow Condition Average (mg/L) | 0.981 | 0.365 | 0.222 | 0.508 | |
| Flow Condition Median (mg/L) | 0.461 | 0.260 | 0.170 | 0.267 | |

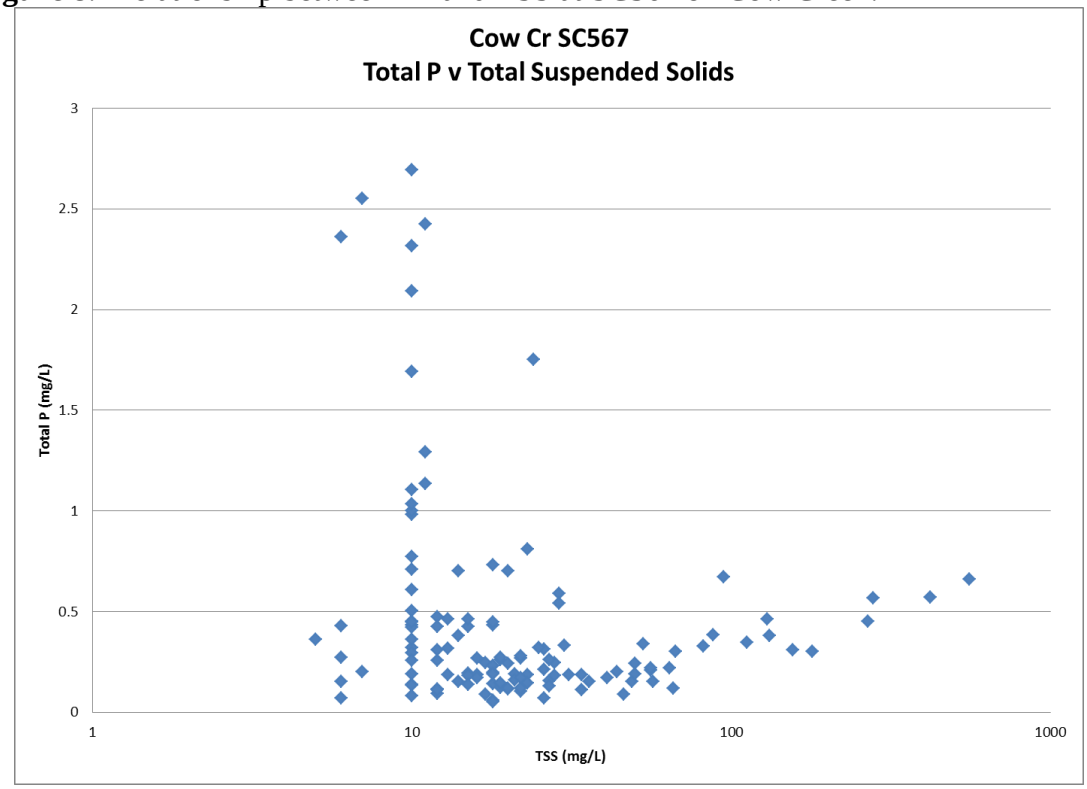
**Figure 7**. Seasonal TP concentrations on Cow Creek at SC567 relative to the percent of flow exceedance.



Because the large variability in ambient phosphorus concentrations, median values are appropriate for determining long-term conditions. Listing on the 303(d) lists for TP was determined by median concentrations exceeding 0.201 mg/L for KDHE stream monitoring stations.

Phosphorus is typically linked to sediment or total suspended solids because of the propensity of those solids to adsorb phosphorus. As seen in Figure 8, TSS levels on Cow Creek are poorly correlated with phosphorus concentrations when TSS concentrations are below 50 mg/L. This notable lack of relation between the two is indicative of the dominant influence of wastewater with the elevated phosphorus and low TSS content within Cow Creek. As TSS concentrations increase over 50mg/L, the TP concentrations trend upward proportionately. This relationship in the data set is typical of higher flow conditions when runoff conditions cause high TSS concentrations, where phosphorous concentrations increase as well.

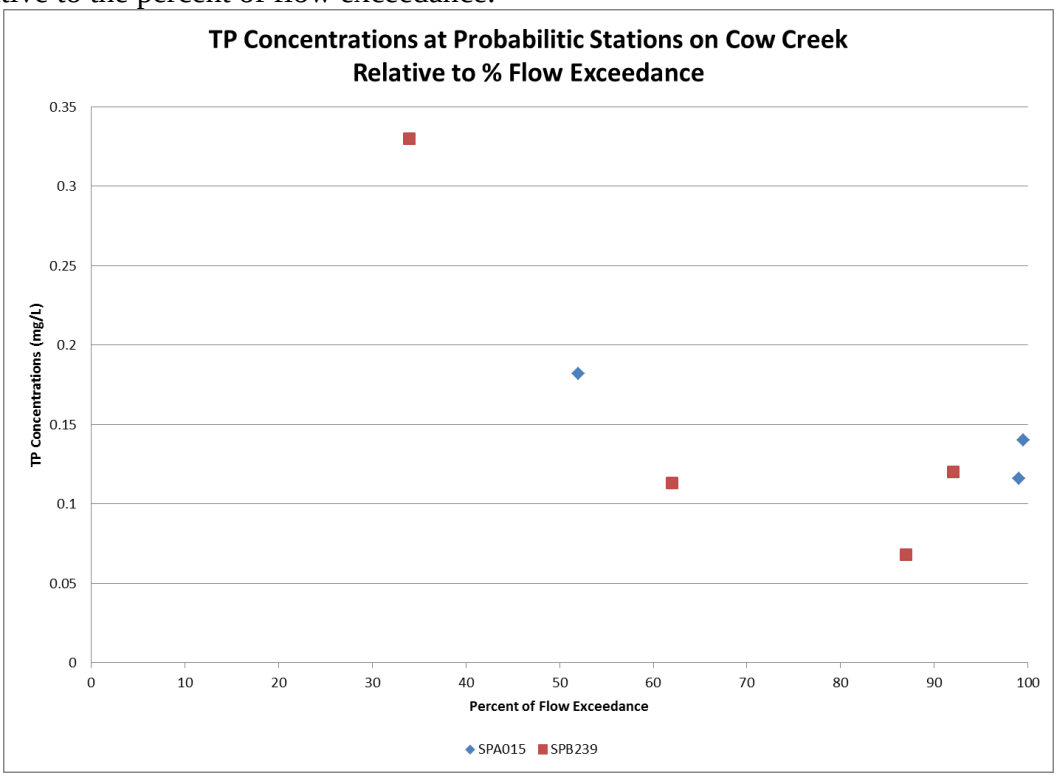
**Figure 8**. Relationship between TP and TSS at SC567 on Cow Creek.




Two KDHE stream probabilistic sampling stations within the watershed were sampled during the sampling years of 2006 and 2012. Station SPA015 was sampled quarterly in 2006 with a TP average of 0.146 mg/L. Station SPB239 was sampled further upstream on Cow Creek on a quarterly basis in 2012 and had an average TP of 0.158 mg/L. Both stations are above the confluence with First Cow Creek and above all but one of the NPDES dischargers in the watershed. The only NPDES facility above these sampling locations is the Crawford County Consolidated RWD 1 facility, which discharges waste associated with the treatment of potable water and has no potential to contribute to the TP

impairment in the watershed. As seen in Figure 9, TP concentrations are higher as flows increase based on the flow conditions with each sampling date, which is indicative when nonpoint source pollutant loading is the primary factor.

**Figure 9**. TP concentrations at the KDHE Probabilistic stations on upper Cow Creek relative to the percent of flow exceedance.




There are three mechanisms in place dictating phosphorus concentrations and critical conditions in the lower reaches of Cow Creek. The first factor is the effect of Pittsburg's wastewater on the downstream hydrology and nutrient content, which influences the high TP concentration critical condition during the low flow condition. The second influence is nonpoint sources in proximity to Cow Creek that contribute direct loadings, primarily during normal and high flows. The final influence is wet weather sources that dominate loading during runoff events, which includes the wet weather impacts of urban stormwater from Pittsburg and runoff from nonpoint sources in the aftermath of rainfall.

**Relationship between Phosphorus and Biological Indicators**: The narrative criteria of the Kansas Water Quality Standards are based on indications of the prevailing biological community. Excessive primary productivity may be indicated by extreme swings in dissolved oxygen or pH as the chemical reactions of photosynthesis and respiration alter the ambient levels of oxygen or acid-base balance of a stream. The relationship between pH and stream temperature is illustrated in Figure 10 for SC567. Higher pH values tend to occur during higher photosynthesis periods. Levels of pH exceeded the criterion of 8.5 at SC567 during three sampling events. The average pH at SC567 is 7.42, which is within the range of the pH criteria for Kansas waters. Figure 11 illustrates the relationship between stream pH and the TP concentration at SC567. Generally, higher

TP concentrations tend to have pH values higher than the average pH value at station SC567. On Cow Creek, dissolved oxygen (DO) tends to swing inversely to the ambient temperature of the stream as seen in Figure 12, which also details the monthly average DO concentrations and temperature at SC567. Monthly average DO concentrations do not go below 5 mg/L at SC567.

**Figure 10**. Relationship between pH and temperature in Cow Creek.

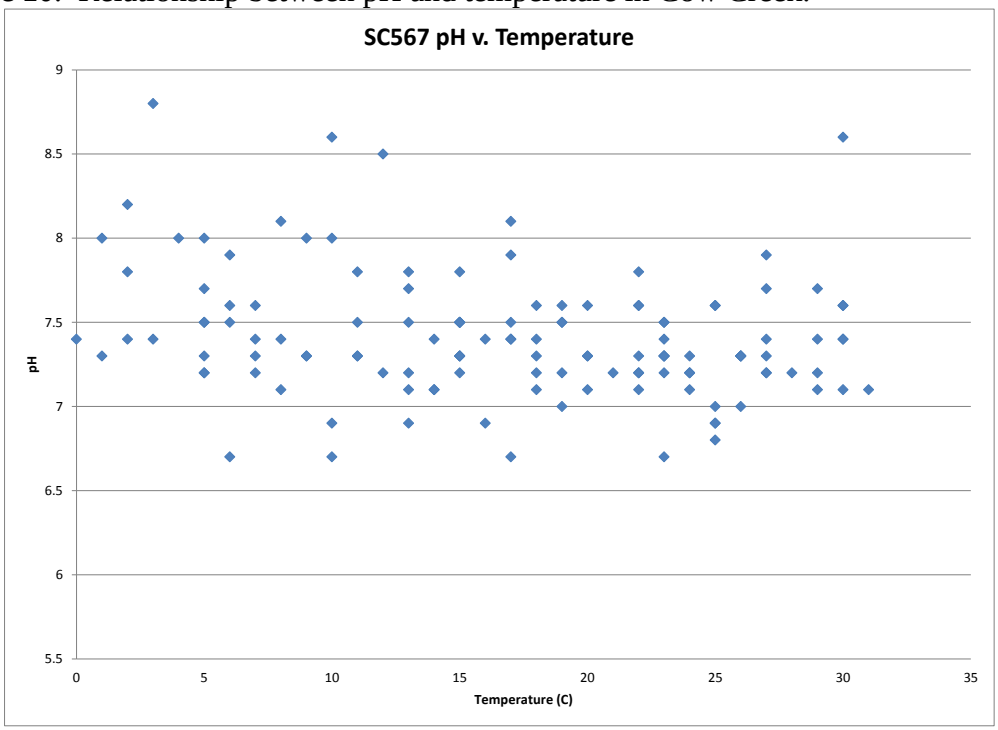



**Figure 11**. Relationship between pH values and TP concentrations at SC567.

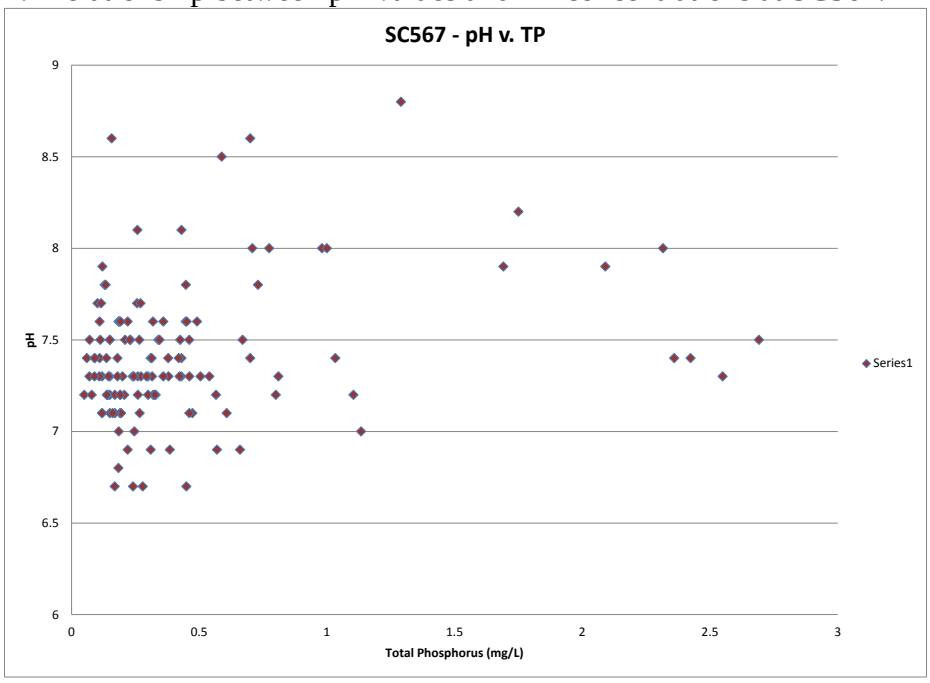
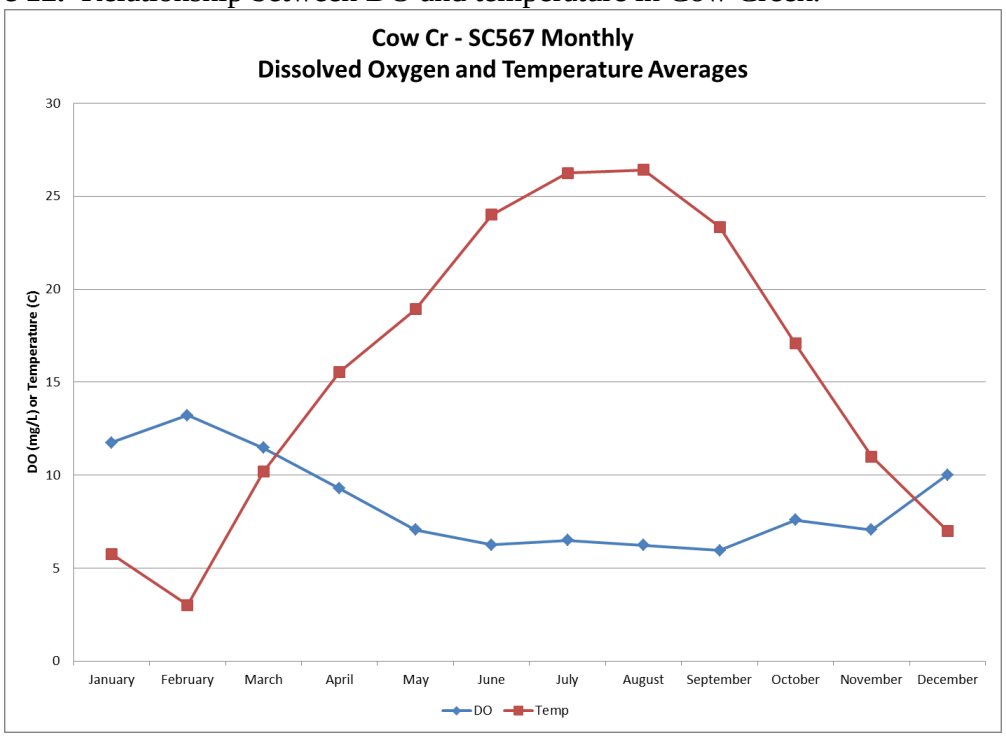


**Figure 12.** Relationship between DO and temperature in Cow Creek.




Current EPA philosophy is predicated on the lowest quartile of stream total phosphorus within an ecoregion as indicative of minimum impact conditions (in absence of reference streams). This generalization is not tied to specific biological conditions, but represents water quality protection policy guiding EPA's administration of clean water programs.

KDHE has not sampled sestonic chorophyll at SC567. EPA's guidance on nutrient criteria for streams (2000) indicated trophic issues in streams with over 8-15 µg/L sestonic chlorophyll. From EPA's work on ambient water quality criteria pertaining to nutrients, median values for summer chlorophyll *a* in the Central Irregular Plains Level III ecoregion 40 for three analytical techniques (fluorometric, spectrophotometric, trichromatic) to be 12.4, 11.8, and 13.5 µg/L, respectively. The three corresponding lower (25%) values are 4.6, 6.8, and 8.5 µg/L.

Figure 13 displays the relationship between the median phosphorus values and ALUS Index scores within the Neosho Basin. The relationship between the median phosphorus values and ALUS Index scores within ecoregions 39a, 40c, and 40d are displayed in Figure 14. High ALUS Index scores are indicative of high quality biological communities. Kansas protocol is to delineate the boundaries between full and partial aquatic life support and between partial support and non-support as ALUS Index score of 14 and 6, respectively. Based on Figure 13, conditions of partial support have a range of phosphorus concentrations from 0.015 mg/L to 0.250 mg/L in the Neosho Basin.

**Figure 13**. ALUS Index scores and the median total phosphorus levels for stations in the Neosho basin. Compiled values indicate compilation of all stations in that Basin.

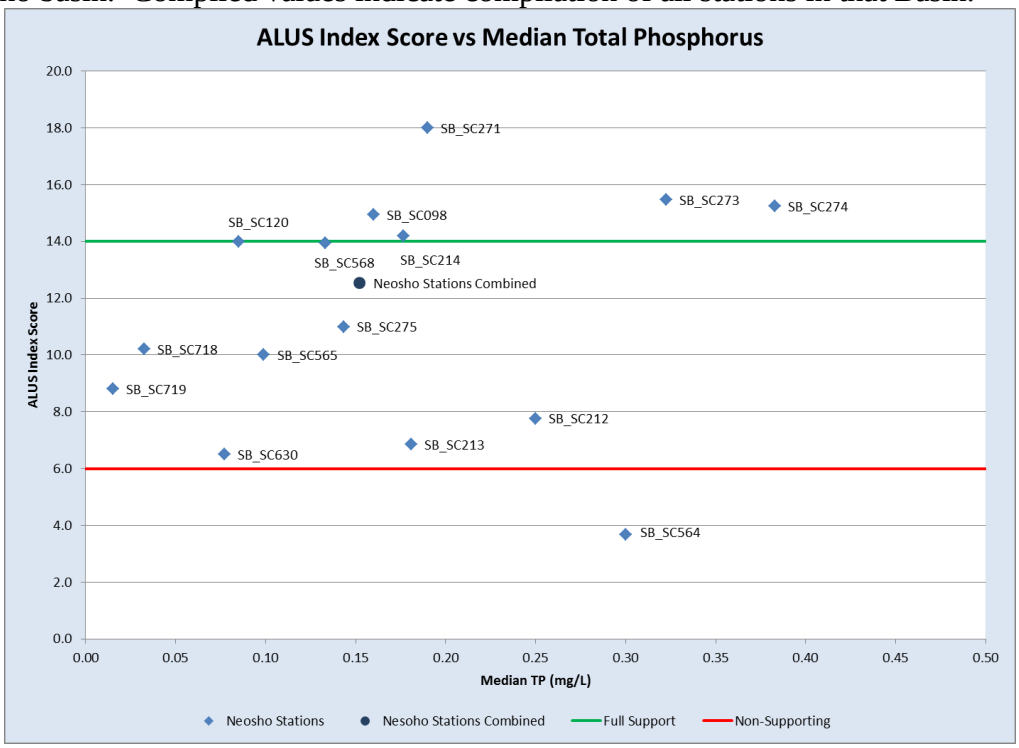
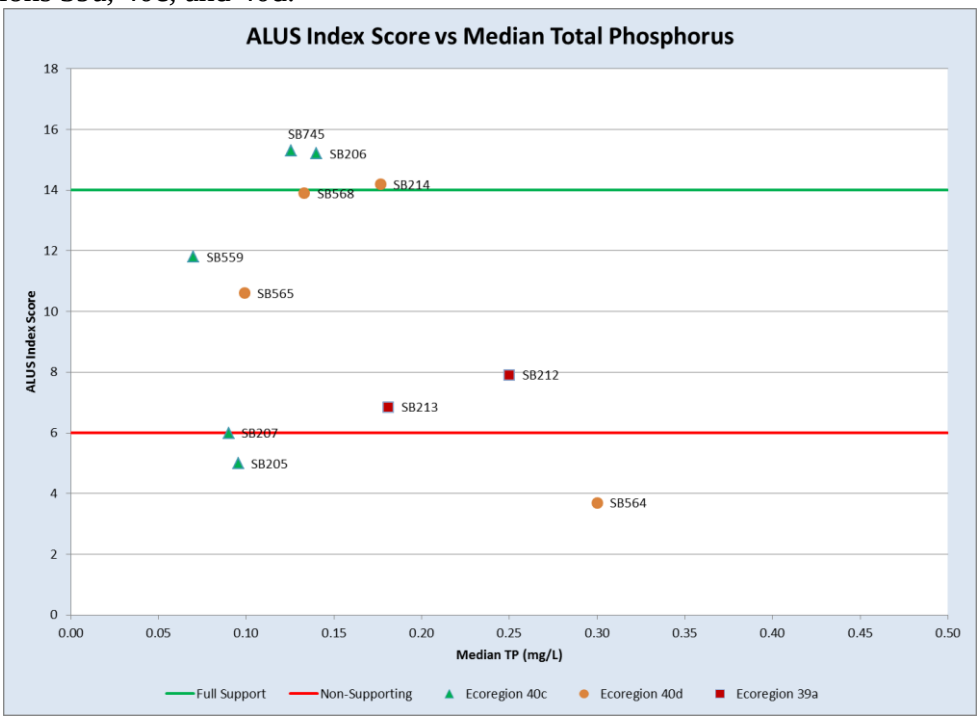



**Figure 14**. ALUS Index scores and the median total phosphorus levels for stations in ecoregions 39a, 40c, and 40d.



**Desired Endpoint**: The ultimate endpoint of this TMDL will be to achieve the Kansas Water Quality Standards by eliminating any of the impacts to aquatic life, domestic water supply or recreation associated with excessive phosphorus and objectionable amounts of algae as described in the narrative criteria pertaining to nutrients. There are no existing numeric phosphorus criteria currently in Kansas.

The original listing for phosphorus at SC567 came about because of median TP values that were greater than 0.201 mg/L. The current EPA suggested stream TP concentration benchmarks for aggregate ecoregion IX streams is 0.0366 mg/L. A similar EPA benchmark for Level III ecoregion 40 streams based on the 25$^{th}$ percentile of data for 146 streams sampled is 0.0925 mg/L (EPA, 2000).

Comparable analysis for stream data collected from 1990-2014 and restricted to the Kansas stations in ecoregion 40d (Central Irregular Plains, Cherokee Plains) from eight stations with the lowest TP concentration average, indicates the average concentration of the pooled data set is about 0.140 mg/L, which has a respective median concentration of 0.110 mg/L. The KDHE sampling stations located in Kansas ecoregion 40d are detailed in Table 3.

**Table 3**. Kansas Ecoregion 40d Stations with the lowest TP concentration average.

| Ecoregion 40d Station | Average | Median |
|---|---|---|
| SC110 | 0.052 | 0.036 |
| SC746 | 0.070 | 0.057 |
| SC747 | 0.079 | 0.069 |
| SC605 | 0.118 | 0.080 |
| SC569 | 0.131 | 0.113 |
| SC565 | 0.143 | 0.100 |
| SC209 | 0.147 | 0.150 |
| SC568 | 0.171 | 0.135 |

The Aquatic Life Use Support Indices (ALUS Index) and sestonic chlorophyll concentrations will serve to establish if the biological community of Cow Creek reflects recovery, renewed diversity and minimal disruption by the impacts described in the narrative criteria for nutrients on aquatic life, recreation, and domestic water supply. The ALUS Index score consists of five categorizations of biotic conditions:

1. Macroinertebrate Biotic Index (MBI): A statistical measure that evaluates the effects of nutrient and oxygen demanding substance on macroinvertebrates based on the relative abundance of certain indicator taxa (orders and families).
2. Ephermeroptera, Plecoptera, and Trichoptera (EPT) abundance as a percentage of the total abundance of macroinvertebrates.

3. Kansas Biotic Index for Nutrients (KBI-N): Mathematically equivalent to the MBI, however the tolerance values are species specific and restricted to aquatic insect orders.
4. EPT Percent of Count (EPT% CNT) – The percentage of organisms in a sample consisting of individuals belonging to the EPT orders.
5. Shannon's Evenness (SHN EVN) – A measure of diversity that describes how evenly distributed the numbers of individuals are among the taxa in a sample.

Once measured, the metrics detailed above are then assigned a score according to Table 4 and the scores are tallied and a support category assigned according to Table 5.

**Table 4.** ALUS Index metrics with scoring ranges.

| MBI | KBI-N | EPT | EPT % CNT | SHN EVN | Score |
|---|---|---|---|---|---|
| <= 4.18 | <= 2.52 | >= 16 | >= 65 | >= 0.849 | 4 |
| 4.19-4.38 | 2.53-2.64 | 14-15 | 56-64 | 0.826-0.848 | 3 |
| 4.39-4.57 | 2.65-2.75 | 12-13 | 48-55 | 0.802-0.825 | 2 |
| 4.58-4.88 | 2.76-2.87 | 10-11 | 38-47 | 0.767-0.801 | 1 |
| >= 4.89 | >= 2.88 | < = 9 | <= 37 | <= 0.766 | 0 |

**Table 5.** ALUS Index score range, interpretation of biotic condition, and supporting, partial and no supporting categories.

| ALUS Index Score | Biotic Condition | Support Category |
|---|---|---|
| 17-20 | Very Good | Supporting |
| 14-16 | Good | |
| 7-13 | Fair | Partially Supporting |
| 4-6 | Poor | Non-supporting |
| 1-3 | Very Poor | |

Therefore, the numeric endpoints for this TMDL indicating attainment of water quality standards in the watershed will be:

1. An ALUS Index score greater than or equal to 14.
2. Sestonic chlorophyll: The concentration of planktonic algae floating in the water column of the stream. EPA (2000) sestonic chlorophyll levels over 8-15 µg/L are problematic. A target value of <5 µg/L will be sought for SC567.

The endpoints have to initially be maintained over three consecutive years to constitute full support of the designated uses of Cow Creek at SC567. After standards are attained, simultaneous digression of these endpoints more than once every three years, on average, constitutes a resumption of impaired conditions.

The endpoints will be evaluated periodically as phosphorus levels decline over time. This TMDL looks to establish management milestones for phosphorus concentrations that would be the cue to examine the biological conditions of the streams. This TMDL established two milestones to achieve the ultimate endpoint of this TMDL. The first milestone will be a reduction of the median TP concentration at SC567 to 0.140 mg/L, based on the approximate average TP values of the pooled data from the sampling

stations within ecoregions 40d that have the lowest TP concentration average. The second milestone will be a reduction of the TP median at SC567 to 0.110 mg/L, reaching the median of the pooled data from the sampling stations within ecoregion 40d that have the lowest TP concentration average.

**Table 6**. TP concentration reductions necessary to meet TMDL endpoints.

| | Current TP Median (mg/L) | Phase I TMDL (mg/Ll) | Phase I Concentration Reduction | Phase II TMDL (mg/L) | Phase II Concentration Reduction (mg/L) |
|---|---|---|---|---|---|
| SC567 Cow Cr | 0.267 | 0.140 | 48% | 0.110 | 59% |

Presuming the first stage of reducing phosphorus levels in the TMDL watershed improves water quality but does not attain the biological indicators, a second stage of implementation will commence. In time, median phosphorus concentrations should approach the median value (0.110 mg/L) of the TP data for the eight stations within ecoregion 40d that have the lowest TP concentration average, encompassing all flow conditions.

Achievement of the biological endpoints indicates any loads of phosphorus are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored. The biological endpoints have to be maintained over three consecutive years to constitute full support.

## 3. SOURCE INVENTORY AND ASSESSMENT

**Point Sources**: There are 16 permitted NPDES facilities located upstream of station SC567. The permitted facilities are categorized as follows: three non-overflowing lagoons that are prohibited from discharging; three industrial facilities; five commercial facilities; four municipal facilities; and one MS4 permit. The permitted facilities are detailed in Table 7.

**Table 7.** NPDES permitted facilities in the watershed.

| KS Permit # | Facility | NPDES # | Design Flow (MGD) | Receiving Stream | Permit Expiration Date |
|---|---|---|---|---|---|
| C-NE57-OO01 | WHISPERING PINES ESTATES | KS0118354 | 0.023 | Second Cow Cr | 6/30/2018 |
| C-NE57-OO02 | OAK HILL MOBILE HOME PARK | KS0085782 | 0.0085 | Cow Cr | 6/30/2018 |
| C-NE57-OO03 | ABLE MANUFACTURING & ASSEMBLY, LLC | KS0091901 | 0.005 | Cow Cr via Unnamed Trib | 6/30/2018 |
| C-NE57-OO04 | PITTSBURG TRUCK N TRAVEL | KS0094391 | 0.00255 | Cow Cr via Unnamed Trib | 6/30/2018 |
| C-NE67-OO01 | BRADFORD ACRES MHP | KS0082392 | 0.0128 | Cow Cr via Unnamed Trib | 6/30/2018 |
| I-NE27-PR01 | O'BRIEN READY MIX - FRONTENAC PLANT | KSG110098 | | First Cow Cr | 9/30/2017 |
| I-NE31-PO01 | CRAWFORD CO CONSOLIDATED RWD 1 | KS0099988 | 0.0022 | Second Cow Cr via Clear Cr vial Unnamed Trib | 12/31/2014 |
| I-NE57-PR02 | AMERICAN CONCRETE CO., INC. | KSG110142 | | E. Cow Cr via Unnamed Trib | 9/30/2017 |
| M-NE03-OO01 | ARMA, CITY OF | KS0045926 | 0.237 | First Cow Cr via Unamed Trib | 6/30/2018 |
| M-NE27-OO01 | FRONTENAC, CITY OF | KS0026131 | 0.53 | First Cow Cr | 6/30/2018 |
| M-NE57-OO01 | PITTSBURG, CITY OF | KS0038954 | 3 | Cow Cr | 4/30/2018 |
| M-NE57-SN01 | PITTSBURG, CITY OF | KSR044017 | | MS4 | 1/31/2019 |
| M-NE67-OO01 | WEIR, CITY OF | KS0079146 | 0.085 | Brush Cr via Unnamed Trib | 6/30/2018 |
| C-NE57-NO04 | CHICKEN MARY'S RESTAURANT | KSJ000206 | | Non-overflowing | 7/31/2019 |
| C-NE57-NO05 | CHICKEN ANNIE'S RESTAURANT | KSJ000205 | | Non-overflowing | 6/30/2019 |
| C-NE67-NO06 | LABETTE COMMUNITY COLLEGE/PITTSBURG | KSJ000179 | | Non-overflowing | 5/31/2019 |

The cities of Arma, Frontenac, Pittsburg and Weir account for the four discharging municipal treatment plants in the Cow Creek watershed. All permits associated with these facilities require effluent sampling for total phosphorus. The cities of Arma, Frontenac, and Weir perform quarterly sampling and the City of Pittsburg performs weekly monitoring. The City of Pittsburg additionally performs weekly influent sampling and weekly downstream monitoring for total phosphorus in Cow Creek.

The cities of Arma and Weir operate three cell lagoon systems. The effluent TP average for the City of Arma is 1.84 mg/L, since monitoring began in 2013. The City of Weir began sampling for TP in 2013 as well and has an effluent TP average of 2.23 mg/L. The City of Frontenac operates a five cell lagoon system and has been sampling TP within their effluent since 2008, which averages 2.0 mg/L. Discharge data for the facilities within the watershed are detailed in Table 8.

**Table 8**. Current TP discharge data for facilities within the Cow Creek watershed.

| KS Permit # | Facility | Avg. TP (mg/L) in Effluent | Design Flow (MGD) | Current Average Flow (MGD) | Permit TP Monitoring |
|---|---|---|---|---|---|
| C-NE57-OO01 | WHISPERING PINES ESTATES | 2.09 | 0.023 | 0.012 | Monthly |
| C-NE57-OO03 | ABLE MANUFACTURING & ASSEMBLY, LLC | 0.83 | 0.005 | NA | Monthly |
| C-NE67-OO01 | BRADFORD ACRES MHP | 1.62 | 0.0128 | NA | Quarterly |
| M-NE03-OO01 | ARMA, CITY OF | 1.84 | 0.237 | NA | Quarterly |
| M-NE27-OO01 | FRONTENAC, CITY OF | 2.00 | 0.53 | NA | Quarterly |
| M-NE57-OO01 | PITTSBURG, CITY OF | 4.46 | 3 | 3.330 | Weekly |
| M-NE67-OO01 | WEIR, CITY OF | 2.23 | 0.085 | NA | Quarterly |

The City of Pittsburg has a mechanical treatment plant and has been monitoring TP since 2003 with an average discharge TP concentration of 4.73 mg/L and a median discharge concentration of 4.6 mg/L. Figure 15 details the annual average effluent TP concentration associated with the City of Pittsburg's discharge. This facility has a permitted daily average flow of 3 MGD and is required to monitor effluent flows on a daily basis. As seen in Figures 16 and 17, the annual and monthly average daily flow associated with this facility is frequently greater than 3 MGD. The average flow since 2003 at this facility is 3.33 MGD and the median flow is 2.5 MGD. However, average flows from Pittsburg since 2008 average 2.77 MGD. During wetter periods the Pittsburg plant experiences additional inflows through infiltration. The plant can accommodate a peak flow of 20 MGD for flow through the facility, with a 14 MGD peak flow capacity for the flow through the tricking filters. The peak flow for the activated sludge unit is 6 MGD. Figure 18 shows a comparison between the TP concentrations in the effluent from the city of Pittsburg and the concentrations observed at SC567. A comparison between the effluent concentrations and the downstream samples obtained by the City of Pittsburg and the samples from SC567 are detailed in Figure 19 for samples collected in 2013 and 2014 with similar collection dates.

**Figure 15**. City of Pittsburg annual effluent average TP concentration.

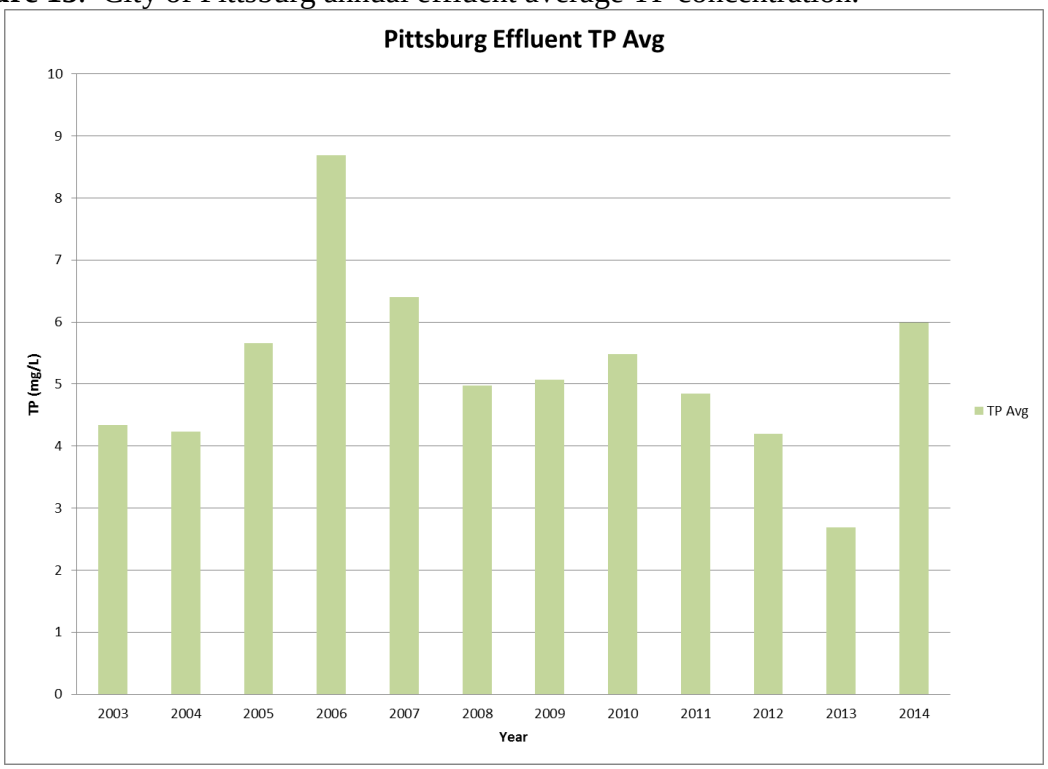



**Figure 16.** Annual average effluent flow from the City of Pittsburg.

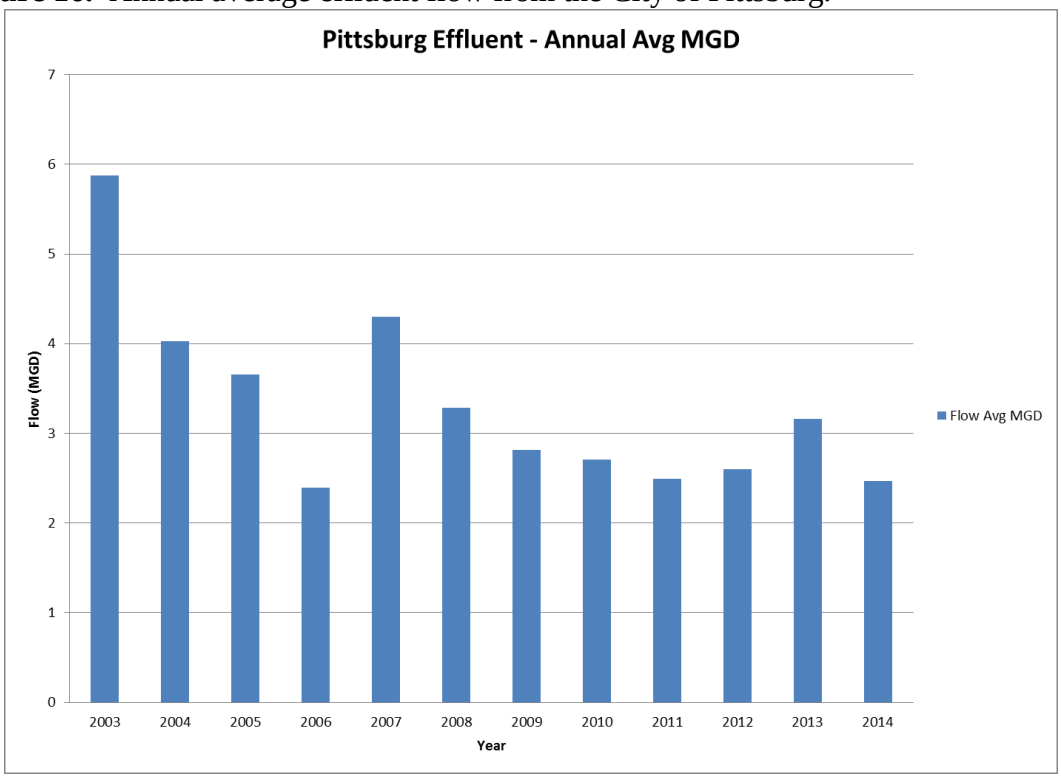


**Figure 17**. Monthly average effluent flow for the City of Pittsburg.

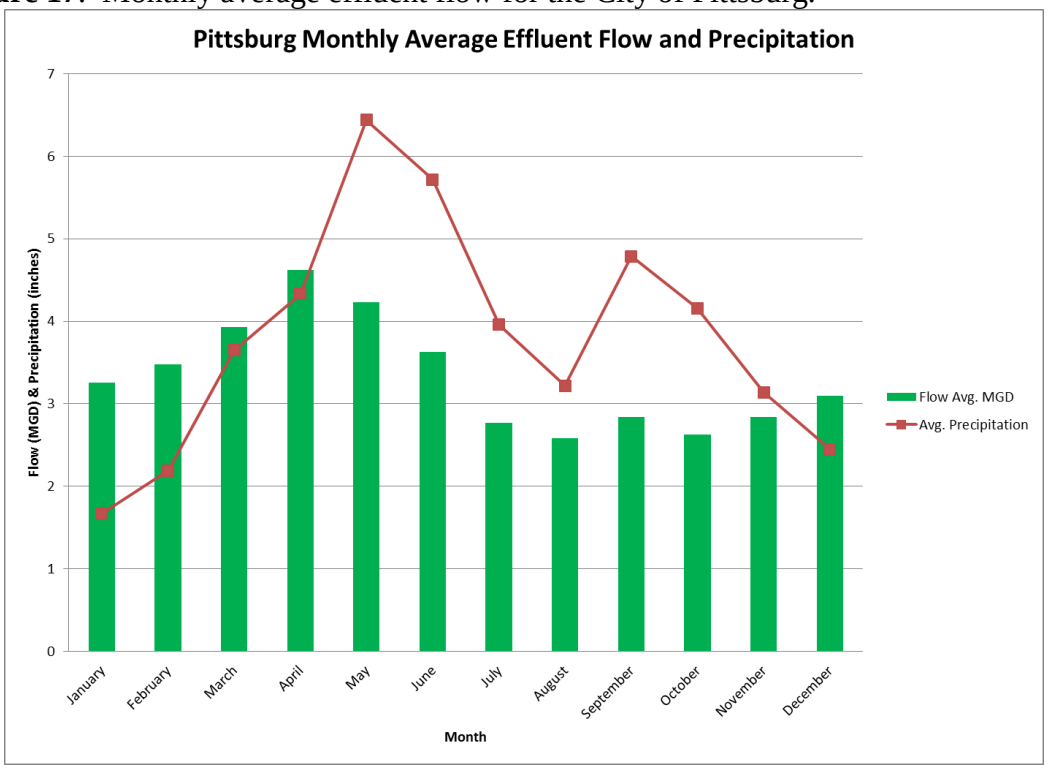



**Figure 18**. Comparison between TP concentrations in Pittsburg's effluent and SC567.

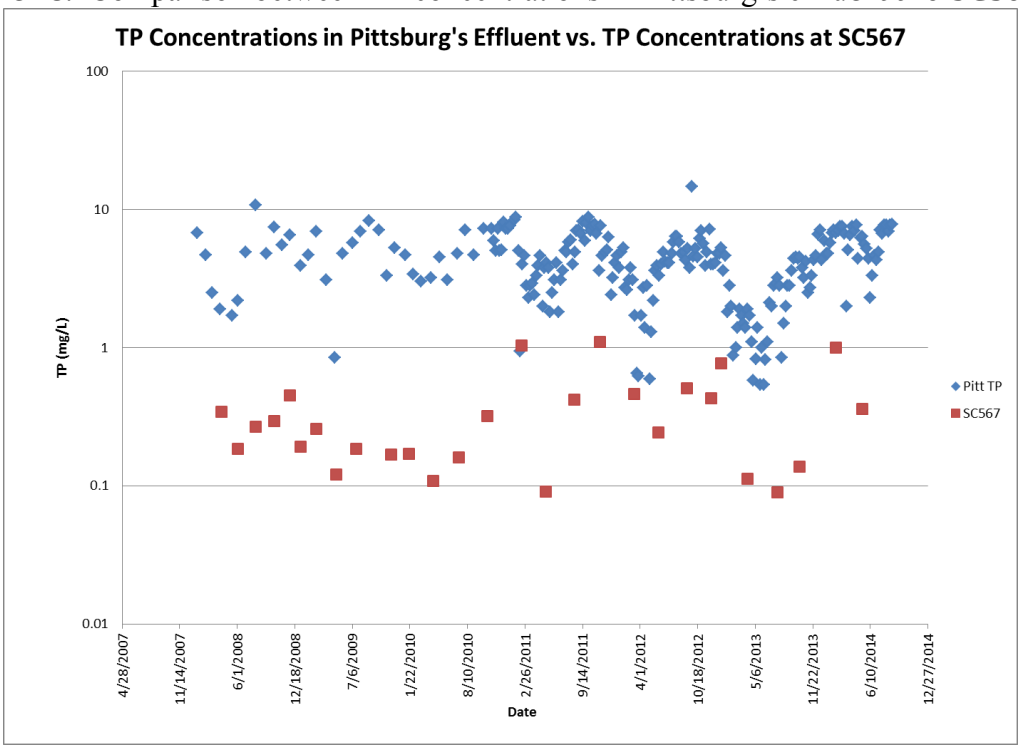
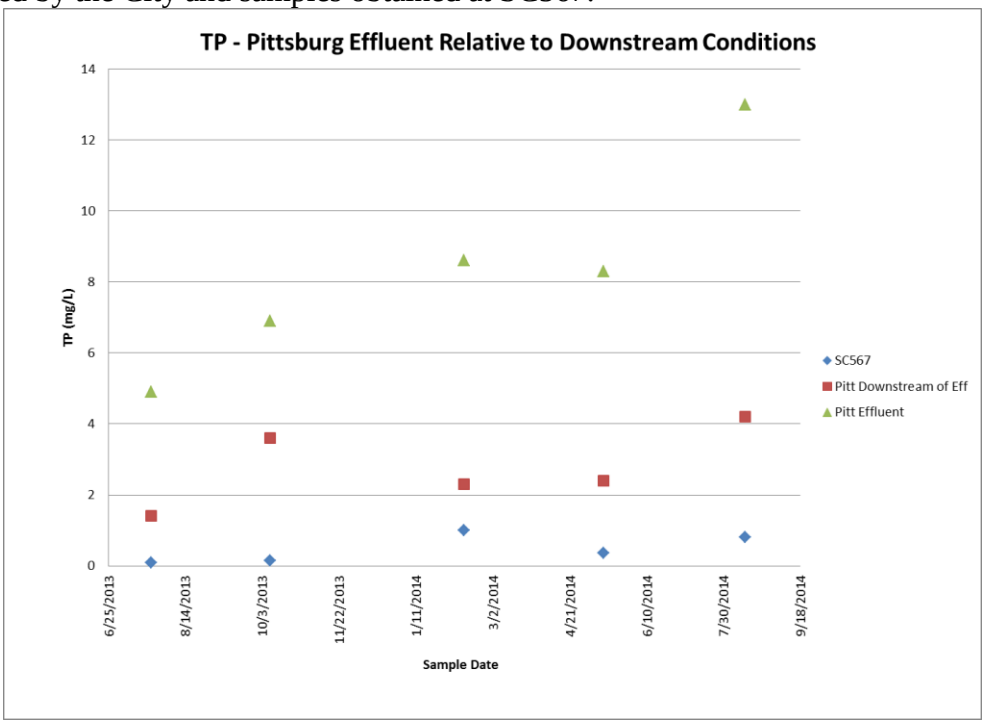


**Figure 19.** Pittsburg's Effluent concentrations relative to the downstream samples obtained by the City and samples obtained at SC567.




Of the five commercial facilities, all but the Pittsburg Truck and Travel facility currently monitor TP in their effluent. The Whispering Pines Mobile Home Park and the Able Manufacturing facilities operate mechanical plants and consistently discharge. The Oak Hill Mobile Home Park operates a lagoon and has no discharge on record. The Pittsburg Truck and Travel facility and the Bradford Acres Mobile Home Park operate lagoon systems that have reported discharges. All of the commercial NPDES facilities within the watershed have potential to contribute to the TP impairment within the watershed, provided they are actively discharging. The current effluent average TP for these facilities is detailed in Table 8.

None of the three industrial facilities monitor TP in their effluent. Two of these are concrete batch plants that have no discharge on record. The Crawford County RWD 1 water treatment plant permit is for the discharge of treated wastewater from a lagoon system from processes associated with the treatment of potable water. They have a design flow of 0.0022 MGD, which may also be utilized for irrigation. The industrial facilities have minimal or no potential to contribute to the TP impairment in the watershed.

The three non-discharging facilities are not contributing to the total phosphorus impairment in the watershed since they do not discharge.

**Livestock and Waste Management Systems**: There are two permitted confined animal feeding operations within the Cow Creek watershed that are detailed in Table 9. These

livestock facilities have waste management system designed to minimize runoff entering their operation and detain runoff emanating from their facilities. These facilities are designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that occurs less than 1-5% of the time. It is unlikely TP loading would be attributable to properly operating permitted facilities, though extensive loading may occur if any of these facilities were in violation and discharged.

**Table 9**. Registered and Permitted Animal Feeding Operations in the Cow Cr Watershed.

| KS Permit # | County | Animal Total | Permit Type | Animal Type |
|---|---|---|---|---|
| A-NECK-F022 | Cherokee | 22000 | Permit | Turkeys |
| A-NECR-M007 | Crawford | 75 | Permit | Dairy |

According to the 2007 Agriculture Census, there are 730 farms with 290,000 acres of farmland in Cherokee County and 810 farms with 337,000 acres of farmland in Crawford County. According to the 2012 Kansas Farm Facts, there are 32,000 head of cattle in Cherokee County and 50,000 head of cattle in Crawford County.

**Population Density**: According to the 2010 Census Track information, the watershed has approximately 35,000 people, with a population density of 146 people/square mile. The populations associated with the cities within the watershed are detailed in Table 10, which account for approximately 25,837 people within the watershed. Population changes from the 2000 to 2010 census show that the population of Frontenac and Pittsburg have increased while the populations of Arma and Weir have decreased.

**Table 10**. Population for municipalities within the Cow Creek watershed.

| City | 2010 Census | 2000 Census | % Change from 2000 to 2010 Census |
|---|---|---|---|
| Weir | 686 | 780 | -14% |
| Frontenac | 3437 | 2996 | 13% |
| Pittsburg | 20233 | 19243 | 5% |
| Arma | 1481 | 1529 | -3% |

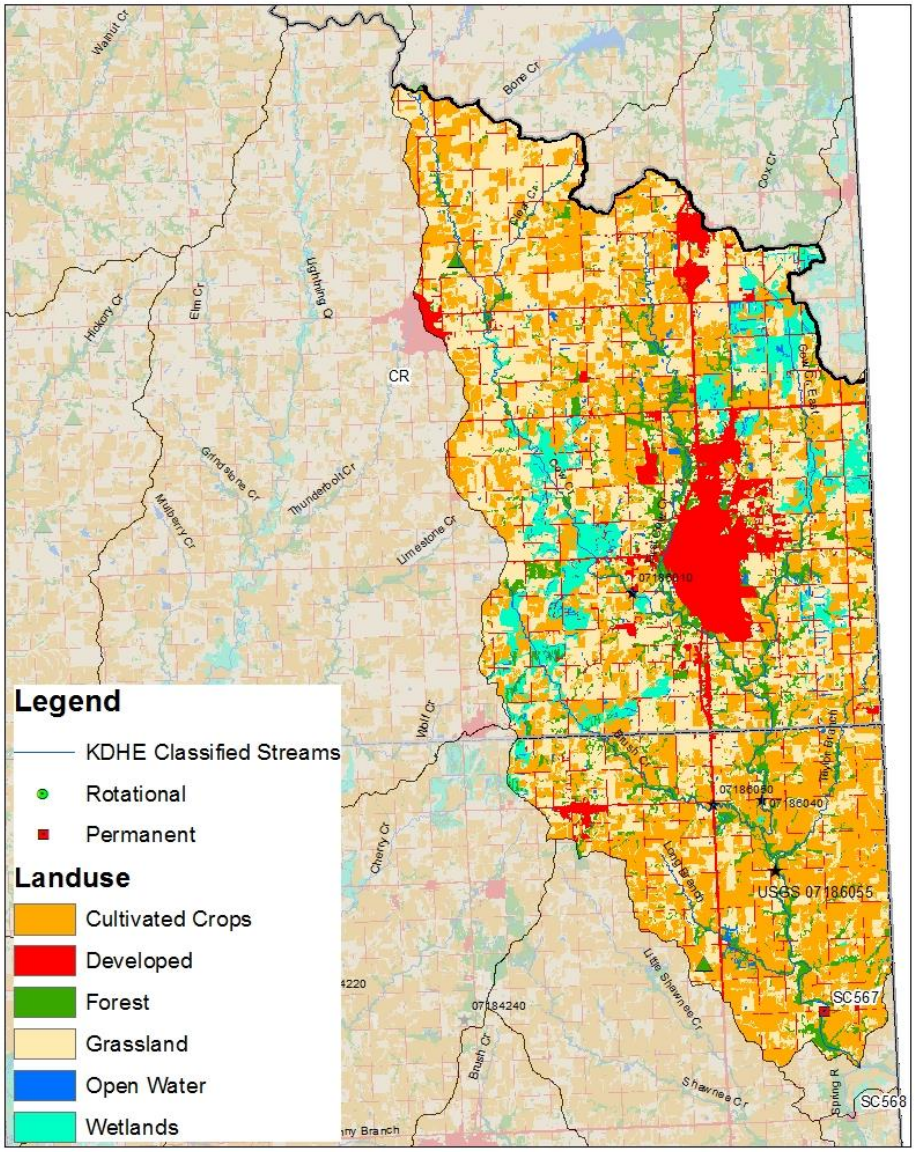
**On-Site Waste Systems**: Households outside of the municipalities that operate wastewater treatment facilities are presumably utilizing on-site waste systems in the watershed. The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was utilized to identify the number of septic systems within the HUC12s within the watershed. According to STEPL, there are approximately 1,535 septic systems within the Cow Creek watershed with an anticipated failure rate of 0.93%. Since 74% of the watershed resides within the municipalities served by wastewater treatment facilities, failing on-site septic systems do not likely contribute to the total phosphorus impairment within the Cow Creek watershed.

**Land Use**: Land use within the Cow Creek watershed is dominated by cropland (37.73%) and grassland (36.17%) according to the 2001 National Land Cover Data (NLCD). Developed areas and forested land account for 10.84% and 7.14% of the watershed respectively. The land use percentages and acres within the watershed are in Table 11 and are further illustrated in the land use map (Figure 20). Runoff from the cropland and developed areas could contribute significant sources of total phosphorus loading.

**Table 11**. Land use acres and percentages in the Cow Creek watershed.

| Land Use | Acres | Percent |
|---|---|---|
| Cropland | 62,189.4 | 37.73 |
| Grassland | 59,632.5 | 36.17 |
| Developed | 17,872.9 | 10.84 |
| Forest | 11,766.6 | 7.14 |
| Wetland | 11,374 | 6.90 |
| Open Water | 2,017.4 | 1.22 |

**Figure 20**. Cow Creek Watershed Landuse map.




**Contributing Runoff**: The Cow Creek watershed has a mean soil permeability value of 0.56 inches/hour, ranging from 0.02 to 4.0 inches/hour according to the NRCS STATSGO database. About 60% of the watershed has a permeability value less than 1.14 inches/hour, which contributes to runoff during very low rainfall intensity events. According to an USGS open-file report (Juracek, 2000), the threshold soil permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. As the watersheds' soil profiles become saturated, excess overland flow is produced. The majority of the nonpoint source nutrient runoff will be associated with cropland areas throughout the watershed that are in close proximity to the stream corridors.

**Background levels**: Phosphorus is present over the landscape, in the soil profile as well as terrestrial and aquatic biota. Wildlife can contribute phosphorus loadings, particularly if they congregate to a density that exceeds the assimilative capacity of the land or water.

## 4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This TMDL will be established in Phases and Stages to progressively reduce phosphorus loadings and ambient concentrations with periodic assessment of the biological endpoints on the lower reaches of Cow Creek. The phases and stages of this TMDL are detailed in Table 12. The TMDL is displayed in Figure 19. The initial phase will entail reductions in phosphorus levels of the Pittsburg wastewater that should translate to an instream median concentration of 0.140 mg/L, approaching the average TP concentration of the pooled data set of the eight KDHE stream chemistry stations with the lowest TP concentration averages within ecoregion 40d. TP load reductions will occur throughout the stream and be monitored at SC567. Reduced upstream TP loading will be indicative as the TP concentrations approach the TP target concentrations, which will result in favorable biological support throughout the stream. Additionally, riparian management in areas adjacent to cropland and livestock management in the vicinity of streams within the watershed should reduce nonpoint source loads under conditions of moderate flows as part of Stage Two.

Once the concentrations at Station SC567 approach the Phase One target of a median TP concentration of 0.140 mg/L, and sestonic chlorophyll < 5 µg/L, an intensive assessment of macroinvertebrate diversity will be made to determine compliance with the narrative nutrient criteria.

**Table 12**. TP TMDL Phases, Stage, Milestones and Actions.

| TMDL Phase / Stage | TP Milestone at SC274 and SC273 | Anticipated Action | Biological Endpoints |
|---|---|---|---|
| I – 1 (NPDES) | 0.140 mg/l | Pittsburg WW BNR and Enhance Disposal by Irrigation; Pittsburg MS4 | ALUS Index Score >= 14<br><br>Sestonic Chlorophyll < 5 µg/l |
| I - 2 (Nonpoint) | 0.140 mg/l | Riparian and Livestock Management | |
| II – 1 (NPDES) | 0.110 mg/l | Pittsburg WW ENR; Pittsburg MS4 | |
| II – 2 (Nonpoint Source) | 0.110 mg/l | Targeted Tributary Riparian Management adjacent to cropland | |

Presuming one or more of the biologic endpoints are not met at the end of Stage One, Stage Two will commence. Additional reductions in loads and phosphorus concentrations will be accomplished through enhanced implementation of controls on non-point sources. The desired target levels are comparable to the median concentrations seen in the pooled data from the eight Kansas stations with the lowest TP concentration averages in ecoregion 40d. A second intensive biological assessment will be made once phosphorus levels approach the Stage Two milestone of 0.110 mg/L of TP at SC567.

**Point Sources**: The Wasteload Allocations (WLA) are associated with the wastewater treatment facilities detailed in Tables 13a and 13b. The WLA for the lagoon facilities have been established based on their design flow and a discharge concentration of 2.0 mg/L, an effluent TP concentration seen from Kansas lagoon systems. The WLA associated with the smaller commercial permitted facilities operating mechanical plants has been established based on their design flow and a discharge TP concentration of 1.5 mg/L for both Phase I and Phase II of this TMDL. The WLA for the City of Pittsburg has been established based on their design flow and a discharge TP concentration of 1.5 mg/L for Phase I and a discharge TP concentration of 0.5mg/L for Phase II. A reserve WLA has been established to account for the inflow and infiltration challenges associated with the Pittsburg facility and to account for future growth within the watershed. The reserve may be portioned and applied to existing, new or expanded NPDES permitted facilities discharging to the Cow Creek watershed.

Use of wastewater for irrigation and efficient operation of the treatment processes at Pittsburg will assist lowering phosphorus loading and concentrations seen at SC567. Prior to the initiation of Phase Two and Enhanced Nutrient Removal at the City of Pittsburg, an evaluation should be initiated to consider the growth in current wasteloads among the facilities. In addition, consideration of assimilation rates of wastewater phosphorus, wasteload trading opportunities among cities, opportunities to further irrigate with wastewater and actual efficiency in phosphorus removal by the mechanical and lagoon systems should be evaluated.

**Table 13a**. Phase I Wasteload Allocations for the Cow Creek watershed.

| KS Permit # | Facility | Design Flow (MGD) | Phase I TP Effluent Concentration | Phase I WLA (lbs/day) |
|---|---|---|---|---|
| C-NE57-OO01 | WHISPERING PINES ESTATES | 0.023 | 1.5 | 0.288 |
| C-NE57-OO02 | OAK HILL MOBILE HOME PARK | 0.0085 | 2 | 0.142 |
| C-NE57-OO03 | ABLE MANUFACTURING & ASSEMBLY, LLC | 0.005 | 1.5 | 0.063 |
| C-NE57-OO04 | PITTSBURG TRUCK N TRAVEL | 0.00255 | 2 | 0.043 |
| C-NE67-OO01 | BRADFORD ACRES MHP | 0.0128 | 2 | 0.214 |
| M-NE03-OO01 | ARMA, CITY OF | 0.237 | 2 | 3.960 |
| M-NE27-OO01 | FRONTENAC, CITY OF | 0.53 | 2 | 8.855 |
| M-NE57-OO01 | PITTSBURG, CITY OF | 3 | 1.5 | 37.592 |
| M-NE67-OO01 | WEIR, CITY OF | 0.085 | 2 | 1.420 |
| Reserve Wastload Allocation | | | | 15.037 |
| TOTAL Phase I WLA | | | | 67.613 |

**Table 13b**. Phase II Wasteload Allocations for the Cow Creek watershed.

| KS Permit # | Facility | Design Flow (MGD) | Phase II TP Effluent Concentration | Phase II WLA (lbs/day) |
|---|---|---|---|---|
| C-NE57-OO01 | WHISPERING PINES ESTATES | 0.023 | 1.5 | 0.288 |
| C-NE57-OO02 | OAK HILL MOBILE HOME PARK | 0.0085 | 2 | 0.142 |
| C-NE57-OO03 | ABLE MANUFACTURING & ASSEMBLY, LLC | 0.005 | 1.5 | 0.063 |
| C-NE57-OO04 | PITTSBURG TRUCK N TRAVEL | 0.00255 | 2 | 0.043 |
| C-NE67-OO01 | BRADFORD ACRES MHP | 0.0128 | 2 | 0.214 |
| M-NE03-OO01 | ARMA, CITY OF | 0.237 | 2 | 3.960 |
| M-NE27-OO01 | FRONTENAC, CITY OF | 0.53 | 2 | 8.855 |
| M-NE57-OO01 | PITTSBURG, CITY OF | 3 | 0.5 | 12.531 |
| M-NE67-OO01 | WEIR, CITY OF | 0.085 | 2 | 1.420 |
| Reserve Wasteload Allocation | | | | 5.012 |
| TOTAL Phase II WLA | | | | 32.527 |

Phase Two would commence if biological information indicated the impacts identified in the narrative criterion for nutrients were still occurring after Phase One was complete. Should the Stage II-1 milestone become the new goal, the wasteload allocation for Pittsburg will be reduced to reflect a typical annual average effluent concentration of 0.5

mg/l from Enhanced Nutrient Removal. In addition, urban best management practices would be installed to reduce loads delivered to Cow Creek by stormwater generated within the jurisdictional limits of Pittsburg under the purview of their MS4 permit.

Actual wasteload allocations attributed to ambient concentrations seen downstream under normal conditions are anticipated to be much less than the allocations of Tables 13a and 13b because of adsorption to sediments and absorption by biota. Table 14 outlines the expected impact of these Wasteload Allocations at SC567 on Cow Creek based on a mass balance analysis of the current loads associated with the City of Pittsburg's wastewater. Under the low flow conditions, wasteloads will be largely reduced through efficient treatment and alternative disposal such as irrigation, so that they match up with the overall Load Capacity. In-stream wasteloads at the low flow condition assimilate, but the City of Pittsburg's WLA accounts for 91% of the load capacity. During the median flow condition, the City of Pittsburg's WLA accounts for approximately 64% of the load capacity at SC567. The mass balance scenarios that detail the percent of load associated with the City of Pittsburg for these conditions are detailed in Appendix B. During the high flow condition, it is conservatively assumed that the entire wasteload from all facilities reach SC567 and do not assimilate.

**Table 14**. Load Capacities and Allocations (lbs/day) at SC567 on Cow Creek under the two TMDL Phases.

| Phase I | | | | | |
|---|---|---|---|---|---|
| Percent Flow | Flow (cfs) | Load Capacity (lbs/day) | WLA (lbs/day) | LA (lbs/day) | MS4 Allocation (lbs/day) |
| 75% | 10.63 | 8.04 | 7.32 | 0.72 | 0 |
| 50% | 33.58 | 25.39 | 16.25 | 8.45 | 0.69 |
| 10% | 316.77 | 239.48 | 67.61 | 158.98 | 12.89 |
| Phase 2 | | | | | |
| Percent Flow | Flow (cfs) | Load Capacity (lbs/day) | WLA (lbs/day) | LA (lbs/day) | MS4 Allocation (lbs/day) |
| 75% | 10.63 | 6.31 | 5.75 | 0.57 | 0 |
| 50% | 33.58 | 19.95 | 12.77 | 6.64 | 0.54 |
| 10% | 316.77 | 188.16 | 32.53 | 143.96 | 11.67 |

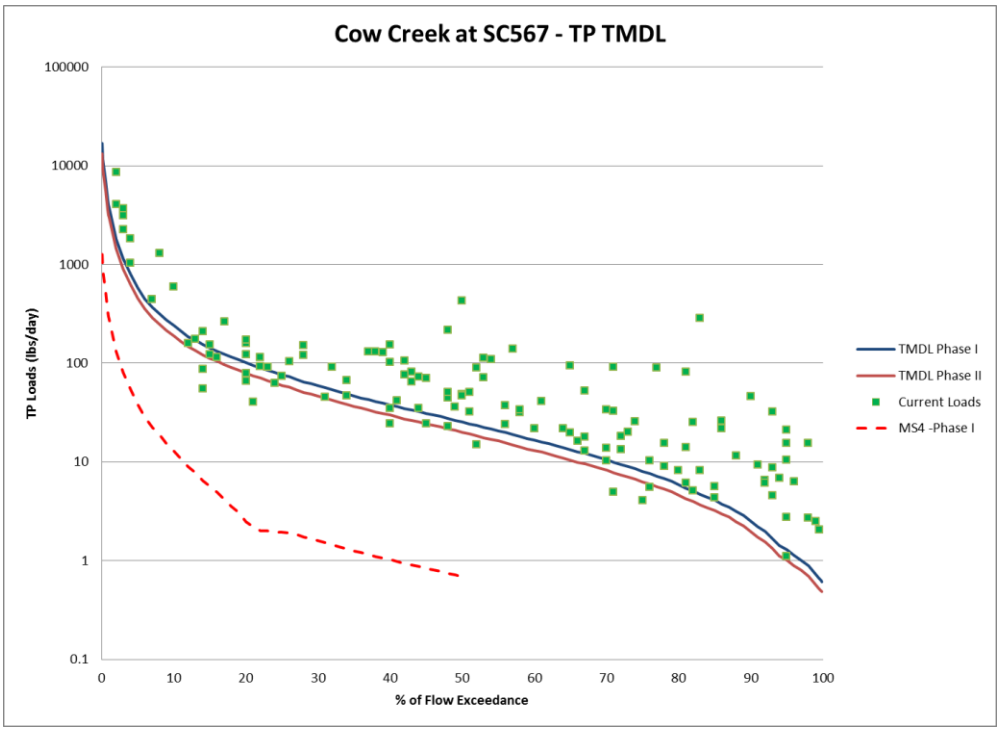
**MS4 Stormwater**: The Wasteload Allocation for the MS4 stormwater is provided by proportioning the remaining load capacity, after accounting for the NPDES WLA, between MS4 and nonpoint source loads. This was done by assuming load contributions would arise from the areas within the City of Pittsburg's boundaries as defined by the 2010 GIS populated places layer. Thus the City of Pittsburg's MS4 WLA is based on the proportion of land within the City's boundaries relative to the total watershed size, which accounts for 5% of the watershed area. An additional MS4 reserve has been allocated for growth and to account for Frontenac if an MS4 permit is issued to them in

the future. This MS4 reserve is an additional 2.5% of the watershed, accounting for Frontenac's portion of the watershed. The total MS4 allocation is therefore 7.5% of the TMDL and only applies to flows at or above median flow conditions at SC567. The MS4 allocations are observed in Table 14 for the median and high flow condition, and further detailed in Figure 17.

**Nonpoint Source Load Allocation**: The load allocation for nonpoint sources is the remaining load capacity after assimilated wasteloads for NPDES wastewater and MS4 stormwater have been accounted (Table 14). Nonpoint sources are assumed to be very minimal at times during low flow conditions when Cow Creek flow is dominated by Pittsburg's wastewater. The load allocation grows proportionately as normal conditions occur. The allocation and contributing areas increase as wet weather ensues.

**Defined Margin of Safety**: The Margin of Safety provides some hedge against the uncertainty in phosphorus loading into Cow Creek, predominantly from the point source dischargers in the watershed. This TMDL uses an implicit margin of safety, relying on conservative assumptions to be assured that future wasteload allocations will not cause further excursion from the nutrient criteria. First, design flows are used for the municipal wastewater discharging facilities to set wasteload allocations, when actual discharge flows will be much less for the facilities utilizing lagoon systems. Additionally, biological endpoints are used to assess the narrative criteria and have to be maintained for three consecutive years before attainment of water quality standards can be claimed. Finally, because there is often a synergistic effect of phosphorus and nitrogen on in-stream biological activity, concurrent efforts by Pittsburg to reduce nitrogen content of its wastewater should complement the offset of phosphorus load reduction in improving the biological condition of Cow Creek.

**Figure 19.** Cow Creek TMDL at SC567.

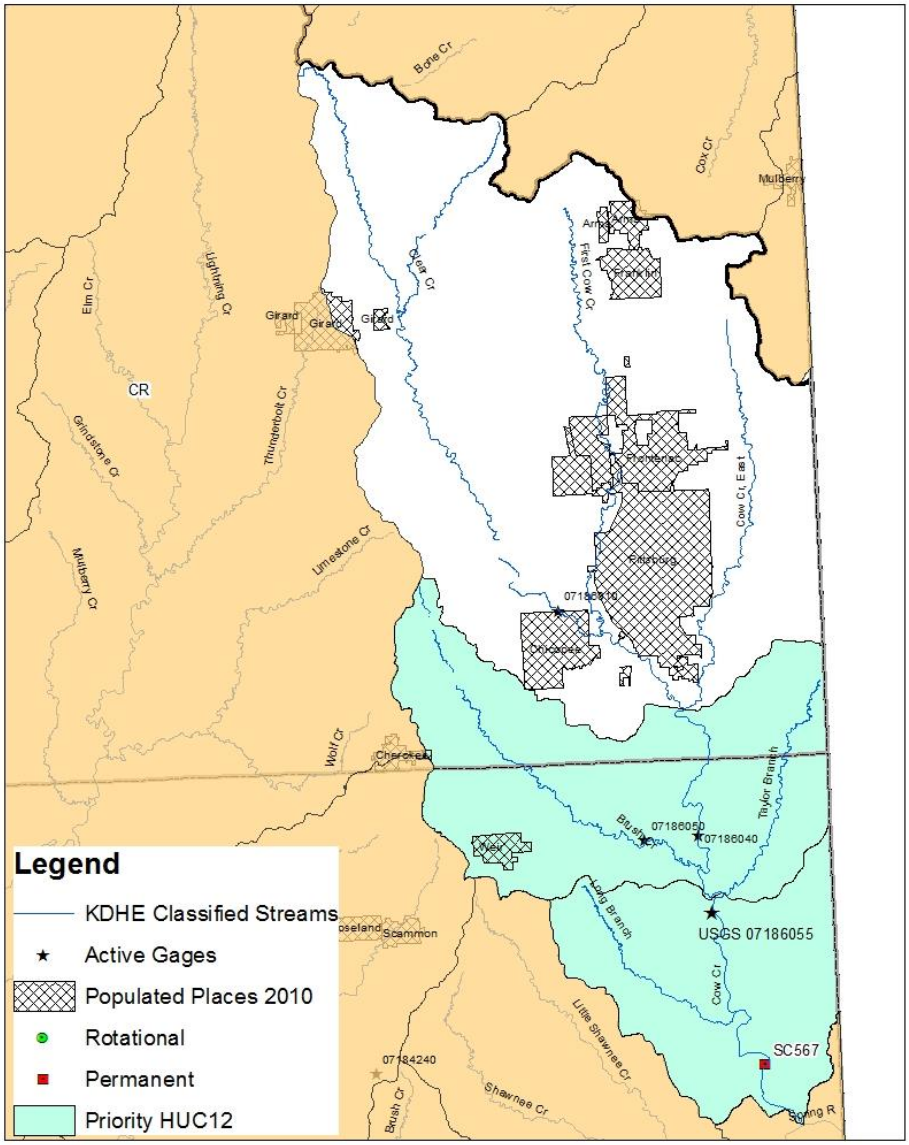



**State Water Plan Implementation Priority**: Phase One priority is focused on wastewater treatment at Pittsburg and riparian management along the stream corridors to effectively reduce the phosphorus loading to the watershed. Phase Two priorities will expand nonpoint source abatement. Additionally, further reduction in wastewater phosphorus loads at Pittsburg will occur. Due to the need to reduce the high nutrient loads in the watershed entering the Spring River, Oklahoma and Grand Lake, this TMDL will be High Priority for Implementation.

**Nutrient Reduction Framework Priority Reduction Ranking**: This watershed lies within the Spring subbasin (HUC8: 11070207), which is among the top sixteen HUC8s targeted for state action to reduce nutrients.

**Priority HUC12s**: Although this TMDL is initially driven by implementation of point source treatment improvements, priority HUC12s within the watershed can be identified based on the cropland areas adjacent to the streams within the watershed. There are two priority HUC12s with the majority of the landuse as cropland that are in the lower reaches of the watershed. The two priority HUC12s are 110702070404 and 110702070405. Nonpoint source reduction efforts within these priority areas should be further prioritized based on the riparian corridors adjacent to the cropland or any livestock facilities.

**Figure 20**. Priority HUC12s for nonpoint source implementation.




## 5. IMPLEMENTATION

**Desired Implementation Activities**:

1. Implement and maintain conservation farming, including conservation tilling, contour farming, and no-till farming to reduce runoff and cropland erosion.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips along the stream and drainage channels in the watershed.
3. Perform extensive soil testing to ensure excess phosphorus is not applied.
4. Ensure land applied manure is being properly managed and is not susceptible to runoff by implementing nutrient management plans.

5. Install pasture management practices, including proper stock density to reduce soil erosion and storm runoff.
6. Ensure proper on-site waste system operations in proximity to the main stream segments.
7. Ensure that labeled application rates of chemical fertilizers are being followed and implement runoff control measures.
8. Make operational changes in wastewater treatment at Pittsburg and alternative disposal such as irrigation and, if necessary, install enhanced nutrient reduction technology to reduce wasteloads.
9. Renew state and federal permits and inspect permitted facilities for permit compliance.
10. Facilitate urban stormwater management in Pittsburg to abate pollutant loads.
11. Support BMP installation efforts by Spring River WRAPS.

**NPDES and State Permits – KDHE**

a. Monitor influent into and effluent from the discharging permitted wastewater treatment facilities, continue to encourage wastewater reuse and irrigation disposal and ensure compliance and proper operation to control phosphorous levels in wastewater discharges.
b. Establish applicable permit limits and conditions after 2018.
c. Inspect permitted livestock facilities to ensure compliance.
d. New livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
e. New registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.
f. Manure management plans will be implemented, to include proper land application rates and practices that will prevent runoff of applied manure.
g. Reduce runoff in Pittsburg through stormwater management program and MS4 permit.
h. Establish TP concentration effluent goal of 1.5 mg/l for the City of Pittsburg and TP permit limits in accordance with the WLA.
i. Assist the City of Pittsburg reduce loading through inflow and infiltration controls.
j. Establish nutrient reduction practices among urban homeowners to manage application on lawns and gardens, through the Pittsburg stormwater management program.

**Nonpoint Source Pollution Technical Assistance – KDHE**

a. Support Section 319 implementation projects for reduction of phosphorus runoff from agricultural activities as well as nutrient management.
b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.
c. Provide technical assistance on nutrient management for livestock facilities in the watershed and practices geared toward small livestock operations, which minimize impacts to stream resources.

d. Engage the City of Pittsburg to discuss stormwater load trading opportunities with the Spring River WRAPS.

**Water Resource Cost Share and Nonpoint Source Pollution Control Program-KDA-DOC**

a. Apply conservation farming practices and/or erosion control structures, including no-till, terraces, and contours, sediment control basins, and constructed wetlands.
b. Provide sediment control practices to minimize erosion and sediment transport from cropland and grassland in the watershed.
c. Install livestock waste management systems for manure storage.
d. Implement manure management plans.

**Riparian Protection Program – KDA-DOC**

a. Establish or re-establish natural riparian systems, including vegetative filter strips and streambank vegetation.
b. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.
c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
d. Coordinate riparian management within the watershed and develop riparian restoration projects.

**Buffer Initiative Program – KDA-DOC**

a. Install grass buffer strips near streams.
b. Consider Conservation Reserve Enhancement Program to hold riparian land out of production.

**Extension Outreach and Technical Assistance – Kansas State University**

a. Educate agricultural producers on sediment, nutrient, and pasture management.
b. Educate livestock producers on livestock waste management, land applied manure applications, and nutrient management planning.
c. Provide technical assistance on livestock waste management systems and nutrient management planning.
d. Provide technical assistance on buffer strip design and minimizing cropland runoff.
e. Encourage annual soil testing to determine capacity of field to hold phosphorus.
f. Educate resident, landowners, and watershed stakeholders about nonpoint source pollution.

**Timeframe for Implementation**: Reduction strategies for Pittsburg wastewater should be evaluated by mid-2016 with subsequent planning, design, and construction of any necessary enhance treatment completed within the next permit cycle after 2019. Urban stormwater management should commence in Pittsburg during 2016. Pollutant reduction

practices should be installed within the priority subwatersheds before 2020, with follow-up implementation over 2020-2024. If biological conditions warrant, Phase Two will begin in 2030 and continue through 2040.

**Targeted Participants**: The primary participants for implementation will be the City of Pittsburg wastewater and stormwater programs, Spring River WRAPS and agricultural and livestock producers operating immediately adjacent to the main stems of Cow Creek. Conservation District personnel and county extension agents should assess possible sources adjacent to streams. Implementation activities to address nonpoint sources should focus on those areas with the greatest potential to impact nutrient concentrations adjacent to these creeks.

Targeted Activities to focus attention toward include:

1. Overused grazing land adjacent to the streams.
2. Sites where drainage runs through or adjacent to livestock areas.
3. Sites where livestock have full access to the stream as a primary water supply.
4. Poor riparian area and denuded riparian vegetation along the stream.
5. Unbuffered cropland adjacent to the stream.
6. Conservation compliance on highly erodible areas.
7. Total row crop acreage and gully locations.
8. High-density urban and residential development in proximity to streams and tributary areas.
9. Residents of Pittsburg should be informed on fertilizer and waste management through the Pittsburg Stormwater Management Program to reduce urban runoff loads.

**Milestone for 2022**: In accordance with the TMDL development schedule for the State of Kansas, the year 2022 marks the next review of the 303(d) activities in the Neosho Basin. At that point in time, phosphorus data from SC567 should show indications of declining concentrations relative to the pre-2014 data, particularly during normal flow conditions. By 2022, the City of Pittsburg should be fully implementing the appropriate measures to decrease the phosphorus content of its wastewaters.

**Delivery Agents**: The primary delivery agents for program participation will be the City of Pittsburg, KDHE, Spring River WRAPS and Kansas State Extension.

**Reasonable Assurances**:
Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution:

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the water of the state.

2. K.S.A. 65-117d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require

permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 2-1915 empowers the Kansas Department of Agriculture, Division of Conservation to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

4. K.S.A. 75-5657 empowers the Kansas Department of Agriculture, Division of Conservation to provide financial assistance for local project work plans developed to control nonpoint source pollution.

5. K.S.A. 82a-901, et. seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

6. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the Kansas Water Plan, including selected Watershed Restoration and Protection Strategies.

7. The Kansas Water Plan and the Neosho Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority implementation.

**Funding**: The State Water Plan annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the Kansas Water Plan. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are located within a High Priority area and should receive support for pollution abatement practices that lower the loading of sediment and nutrients.

**Effectiveness**: Use of Biological Nutrient Removal technology has been well established to reduce nutrient levels in wastewater, including phosphorus. Additionally, nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. In addition, the proper implementation of comprehensive livestock waste management plans has proven effective at reducing nutrient runoff associated with livestock facilities.

## 6. MONITORING

Future stream sampling will continue to occur quarterly at sampling stations SC567. The monitoring will include the sestonic chlorophyll sampling at SC567. Monitoring of tributary levels of TP during runoff events will help direct abatement efforts toward

major nonpoint sources. Monitoring of TP below the Pittsburg outfall in Cow Creek will help assess improvements in their nutrient removal processes. Monitoring of TP should be a condition of the Pittsburg MS4 permit within the watershed.

Commencing in 2017, macroinvertebrate sampling will occur at accessible locations on Cow Creek within the watershed. The streams will be evaluated for possible delisting after Phase One implementation in 2024. If the biological endpoints are achieved over 2019-2023, the conditions described by the narrative nutrient criteria will be viewed as attained and Cow Creek at SC567 will be moved to Category 2 on the 2024-303(d) list. If they are not, Phase Two of this TMDL begins in 2030.

Once the water quality standards are attained, the adjusted ambient phosphorus concentrations on Cow Creek will be the basis for establishing numeric phosphorus criteria through the triennial water quality standards process to protect the restored biological and chemical integrity of the rivers.

## 7. FEEDBACK

**Public Notice**: An active Internet Web site is established at http://www.kdheks.gov/tmdl/planning_mgmt.htm to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Neosho Basin.

**Public Hearing**: A public Hearing on this TMDL was held on … to receive public comments. No comments were received.

**Basin Advisory Committee**: The Neosho River Basin Advisory Committee met to discuss the TMDLs in the basin on March 6, 2014 in Marion.

**Milestone Evaluation**: In 2022, evaluation will be made as to the degree of implementation that occurred within the watershed. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303(d) Delisting**: Cow Creek at SC567 will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2015-2023. Therefore, the decision for delisting will come about in the preparation of the 2024-303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

**Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process:** Under the current version of the Continuing Planning Process, the next anticipated revision would come in 2016, which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made into the WRAPS watershed plans. Recommendations for this

TMDL will be considered in the *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2015-2023.

*May 1, 2015*

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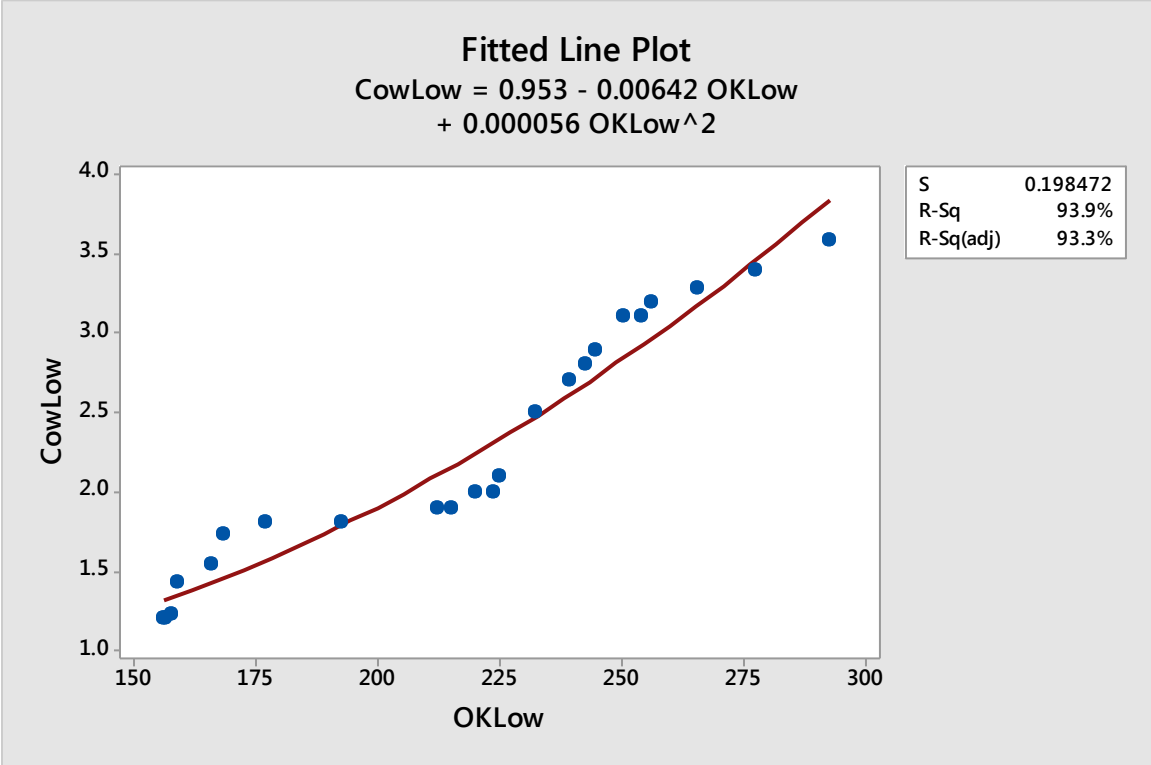
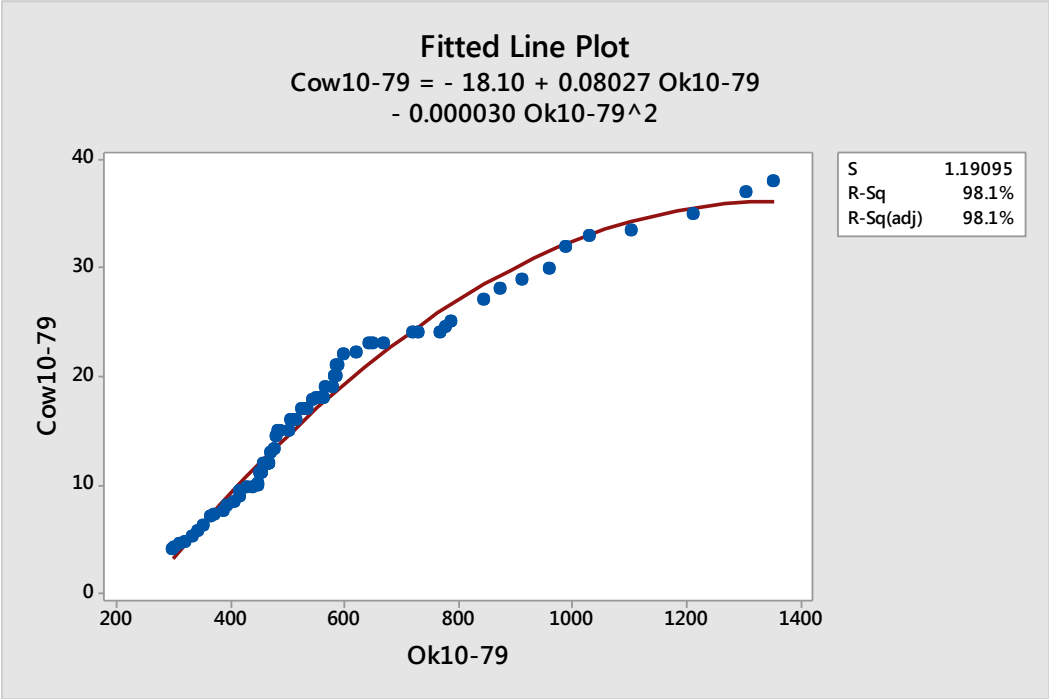
Appendix A – Regression calculations utilized to estimate long term flow conditions.

Regression calculations were performed for the percent flow exceedance range of flows 80-99.9% (Regression A) and 10-79% (Regression B) between the USGS gage 07188000 on Spring River and USGS Gage 07186055 on Cow Creek for a common flow period during 2014. Flow value results for Cow Creek from the Regression B calculation were ignored for the 10-49% flow exceedance range and USGS Perry Values were utilized for the 25% and 10% flow exceedance values. Regression C was run between the results for the Cow Creek flow on the first regression formulas and Perry values to the long term flow condition on Spring Creek at USGS gage 07188000 (1990-2014). For the final Cow Creek flow values, the low flow values calculated from Regression A were utilized for the 94-99.9% flow exceedance values to maintain positive numbers. Otherwise Regression C was used as the final flow values for Cow Creek.

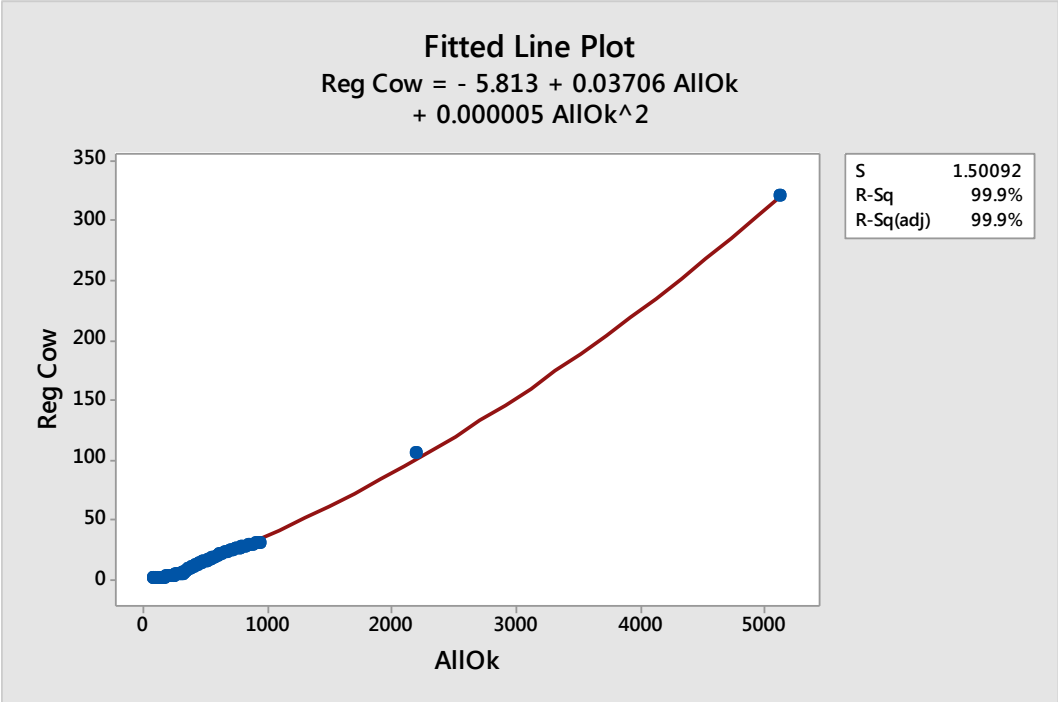
**Regression A**. Regression between 80-99.9% flow exceedance values based on common flow dates during 2014 from USGS Gages 07188000 on Spring River and 07186055 on Cow Creek.



**Regression B**. Regression between 10-79% flow exceedance values based on common flow dates during 2014 from USGS Gages 07188000 on Spring River and 07186055 on Cow Creek.




**Regression C**. Regression between Cow Creek regression results[from Regression A (80-99.9% flow exceedance), Regression B (50-79% flow exceedance) and USGS Perry (25% and 10% flow exceedance values)] and long term USGS 07188000 Spring River (1990-2014).



**Appendix B.** Mass Balance estimate to determine Pittsburg's wastewater effect on SC567 at the 50% and 75% flow condition.

| 50% Flow Mass Balance | Flow | TP Concentration | TP Load (lbs/day) | % of Load |
|---|---|---|---|---|
| Pittsburg | 4.641 | 3.33 | 83.45 | |
| Pitt Assim | 4.641 | 1.7 | 42.60 | 64.37 |
| Watershed Flow | 28.939 | 0.152 | 23.75 | 35.89 |
| SC567 | 33.58 | 0.365 | 66.19 | |
| | | | | |
| SC567 Balance | 33.58 | 0.366 | 66.36 | |

| 75% Flow Mass Balance | Flow | TP Conc. (mg/L) | TP Load (lbs/day) | % of Load |
|---|---|---|---|---|
| Pittsburg | 4.641 | 3.33 | 83.45 | |
| Pitt Assim | 4.641 | 2.05 | 51.38 | 91.27 |
| Watershed Flow | 5.989 | 0.152 | 4.92 | 8.73 |
| SC567 | 10.63 | 0.981 | 56.31 | |
| | | | | |
| SC567 75% Balance | 10.63 | 0.981 | 56.29 | |